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NOTICES:—All communications relating to editorial matter should be addressed to the Editor, who will be pleased to consider articles or contributions dealing with modern chemical developments or suggestions bearing upon the advancement of the chemical industry in this country. Communications relating to advertisements or general matters should be addressed to the Manager.

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Chemical Storage and Transport

THE subject of the storage, packing, handling, and transport of chemicals is dealt with from several points of view in this issue. The variety of substances covered by the term "chemicals" is so wide, ranging from fine powders and essences to heavy acids carried in huge tanks, that it is impossible to select more than a few examples, and the corresponding variety in the methods employed in package, storage, and transport is equally beyond detailed description. But the matter appearing in our pages to-day gives a general idea of the many ways in which the needs of the industry are now being met, and the immense advance that has taken place in design, materials, and general convenience and safety in handling. The reminiscences of thirty years ago contributed by "Chemical Engineer" convey some idea of how differently matters are handled to-day from what they were in former days.

Two important general points are made in the article contributed by a well-known industrial chemist, who has seen much of the inside working of large chemical concerns. The first is the commercial importance of packing and placing products on the market in an

attractive form. The second is the vital importance of safety, as illustrated—happily only at rare intervals—by disastrous explosions and fires. The last consideration, indeed, may be described as the most fundamental of all, for, as many chemicals necessarily come under the head of "dangerous goods," inattention may result not only in loss of life but in heavy damage to property and plant. Although there is still room for inventive devices for protection against danger and for the saving of labour and trouble, a more scientific spirit is now brought to the problems of storage, packing, and transport, and the resources of modern manufacture and design are generally equal to any demands made upon them. Conservative as British firms are reputed to be in their methods, of late years there has been a considerable relaxation of this stiff hostility to change, and a firm that produces something new that is really valuable may generally count on the appreciation of a sufficient number of buyers to make it worth their while. In this matter, the growth in the size of companies and the greater complexity of processes have distinctly helped progress. For the need of economical methods and the large financial resources for meeting the need have resulted in a much speedier taking up of improvements than was the case in former days.

Problems of Coal Hydrogenation

IT has been known for some time that large-scale work on the Bergius process in Germany has given rise to some serious problems. Growing experience (though on a small scale) in this country is beginning to indicate the exact nature of the problems in question. There is no doubt that the high pressures involved put a serious strain on the container, but recent experience points to another difficulty, *e.g.*, the effect of hydrogen on the material of the container. At the Fuel Research Station, coal hydrogenations are carried out in containers of mild steel. It is to be expected that after exposure to hydrogen at high pressure, this steel will contain some hydrogen. Nobody, however, could have foreseen the surprising result obtained on investigation at the National Physical Laboratory, where mild steel which had been used in a Bergius hydrogenation apparatus was found to contain 180 cubic centimetres of hydrogen in each 100 grams of material.

Adsorption of hydrogen by various substances is not a new phenomenon; the behaviour of palladium in this respect is well-known; but that mild steel should adsorb this relatively enormous quantity of hydrogen, and, having adsorbed it, should retain it at atmospheric pressure, is positively startling. Accompanying this adsorption of hydrogen is an embrittlement of the steel, which, in view of the high pressures involved, is a rather disturbing phenomenon. This

difficulty will doubtless be overcome, as presumably it arose and was overcome in Germany. It is, however, an indication of the surprises in store for those who operate under conditions (whether of temperature, pressure, or other kinds) which differ markedly from those of normal experience.

The Chemical Merchant's Outlook

THE presidential address of Mr. Victor Blagden, at the annual meeting of the Chemical and Dyestuffs Traders Association on Thursday in London, frankly recognises the handicaps under which the chemical merchant has to operate to-day, as compared with the freer trading conditions of former times, and emphasises the obvious moral that, with the limitation of free markets and the increase in departmental restrictions, the merchant class need an alert defensive organisation more than ever before. His review of the activities of the Association during the past year leaves no doubt as to its care in watching over merchanting interests and the appeal it should make to the support of the merchanting class.

Apart from the restrictions imposed under the Safeguarding of Industries Act, Mr. Blagden had a good deal to say about the "fine" chemical list to which some additions have recently been made. Rightly or wrongly, the Association have a suspicion that the recent case of calcium biphosphate may be the forerunner of others of a similar nature, and that it may be the "first move to get a wide range of admittedly 'heavy' or industrial chemicals included in the list as 'fine' chemicals." They make no concealment of their intention to resist any efforts in this direction. Shortly, their position is that while not opposed to the establishment of bona-fide key industries for the defence of the country, they object to the Safeguarding Act being used to obtain general protection for branches of the chemical industry already well established and standing in no need of special protective measures.

Rationalisation in Industry

In his recent address to the Faculty of Economics of the University of Cambridge on "Rationalisation in Industry," Sir Alfred Mond—or Lord Melchett, as we must now get accustomed to thinking of him—not only laid down some broad principles, but mentioned two examples of great interest to chemical industry. Rationalisation he described simply as the adjustment of industrial production to consumption. The problem is largely the result of war conditions, under which enormous works were rapidly built and productive capacity forced up to an abnormal limit to meet abnormal needs, with the result that peace found Europe over-supplied with factories for which in peace conditions there was only a partial need. Lord Melchett points to the chemical industry as indicating the only sane policy in such a situation. "When," he points out, "we found ourselves at the end of the war with factories put up to make in one day quantities of explosives which in peace time would not be consumed in a year, the wise and rational decision was taken not to try to run these factories for purposes for which they were entirely unsuitable, but to scrap them.

That same policy enabled the chemical industry, at any rate, among the heavy industries, to maintain the even tenor of a wise and profitable existence."

Another instance quoted was that of the German potash industry. The Potash Trust, which virtually controls the potash production of the world, were confronted with a position in which the production of potash was almost double what they could sell. They did not hesitate to shut their works down and reduce their productive capacity by almost 50 per cent. "It was," in Sir Alfred Mond's words, "a drastic surgical operation, but it saved the patient." The general conclusions put forward were two. Firstly, that a production capacity entirely out of balance with consumption capacity necessitates the ruthless elimination of a large amount of plant, and especially of obsolete plant. Secondly, that efficient production can only be achieved by large scale units, securing cheaper manufacture, more concentrated management, lower overhead costs, greater financial strength, more power in negotiation, larger scope in sales possibilities and greater resources for research.

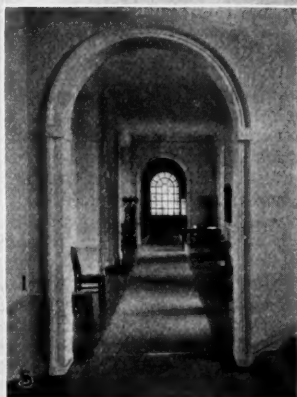
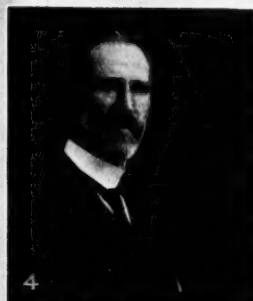
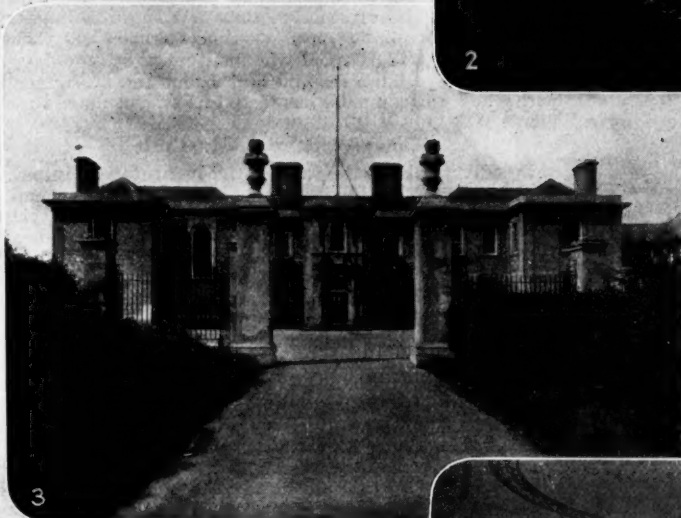
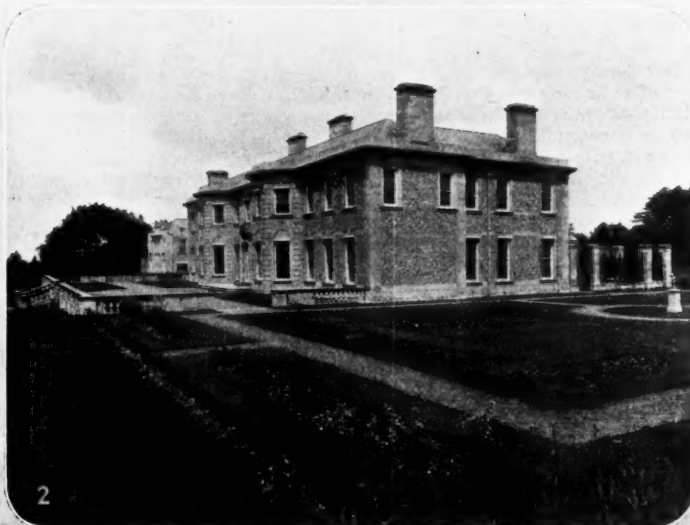
Industrial Research on the Alcohols

THE illustrated account, published in this issue, of the fine new research institute established at Great Burgh by the Distillers Company, is interesting, not merely as an example of modern technical equipment and organisation, but still more as indicating the new fields now open to industrial research. From an institution concerned commercially and primarily in alcohol as a potable spirit, the Distillers Company promises to become a chemical research organisation of the first importance in relation to the alcohols generally as raw materials in chemical manufacture. It is their intention, for example—now made public, we believe, for the first time—to manufacture acetic acid, both as vinegar and as "glacial" acid, to meet the requirements of the home market for acetone, butanol, and similar substances. They are at present producing high grade esters, and they expect before long to manufacture on a large scale a wide range of solvents and plasticisers required in the preparation of cellulose lacquers. A much wider field of industrial research and production is thus being opened out, and the company may be congratulated on appreciating the importance of recognising the needs and the opportunities of the future. Not every commercial organisation has the vision to see so far ahead.

The Calendar

July 9 & 10	Merchandise Marks Inquiry: Pumps. 11.30 a.m. on Monday, July 9, and 10.30 a.m. on Tuesday, July 10.	Board of Trade, Great George Street, London.
9 to 14	Royal Photographic Society: International Congress of Photography.	London.
10	University College, Nottingham: Opening of the New University College Buildings.	Nottingham.
12	Institute of Physics: "Physics in Photography." Dr. C. E. Kenneth Mees. 8 p.m.	Institution of Electrical Engineers, Savoy Place, London.
Sep. 3-7	Society of Chemical Industry: Annual General Meeting.	New York, U.S.A.

Views of the Distillers Co.'s New Research Institute



1. DR. EYRE. 2 AND 3. EXTERIOR VIEWS OF GREAT BURGH. 4. MR. W. H. ROSS (CHAIRMAN AND MANAGING DIRECTOR OF THE COMPANY). 5. WEST CORRIDOR. 6. THE CONFERENCE ROOM.

The Distillers Company's New Laboratory

A Model Industrial Research Institute

An account is given below of the Industrial Research Institute, recently established at Burgh Heath, near Epsom, by the Distillers Co. under the direction of Dr. J. Vargas Eyre. Illustrations of the building, grounds, laboratories, etc., together with photographs of Mr. W. H. Ross (Chairman and Managing Director of the Company), and Dr. Eyre (Director of Research), appear on pp. 593-595.

The Distillers Company, in the purchase, equipment and staffing of their new research institute at Epsom, have set a standard that many similar organisations must envy and some, it is to be hoped, may be induced to copy. There is nothing quite like it, to our knowledge, in this country. The building, known by the pleasant name of Great Burgh, and standing some 500 feet up on the Downs, was originally intended to be a private country residence, but was never actually occupied as such. Externally, it is a large and dignified house with a certain Georgian comfort and solid stateliness about it. The great gates, flanked by high stone pillars, through which the visitor passes to the main entrance, after a pleasant run through the woods, gives a favourable first impression that later is not belied but everywhere confirmed. The lofty corridors, the beautiful staircase, the spacious, airy and well-lighted rooms, have all the quiet repose and dignity of an English country mansion. The library, the largest apartment in the main building, is a real temple of peace. The conference room, with its beautiful oak panelling and carving, is given a regal touch by the crimson leather in which the chairs are upholstered. From the broad terrace one has a delightful picture of undulating woodland and pasture. Altogether a beautiful country house, with an ideal setting of some 25 acres of copse and meadow, converted from a potential residence into a great institute of industrial research.

The organisation and administration of this department of the Distillers Co. has been entrusted to Dr. J. Vargas Eyre, who, as many will know, has had considerable experience in work of this kind, having shown marked administrative ability, for example, in building up a scientific research and advisory organisation for the linen industry. It is no small testimony to his energy and leadership that within the short space of fifteen months he has converted a skeleton into a living entity, of which every section is actively and efficiently working. On every hand one cannot fail to be impressed by the business-like way in which the department is being run: the co-operative spirit, often so hard to engender in scientific workers, is already evident at Great Burgh, and the whole staff seem to be working together in a family spirit.

Aims and Scope of the Enterprise

What is the idea of this handsome enterprise by the Distillers Company? Shortly, it is to centralise their hitherto scattered scientific work; to organise collective effort to elucidate problems arising in their organisation and to ensure that their future developments are on a sound foundation.

On the occasion of a recent visit, Dr. Eyre gave an interesting account of their work to this end. "As you may know," he said, "in the past the Distillers Company had well-established research laboratories in London, Belfast, Bristol, Stirling and Liverpool, which were mainly occupied with the biological control of their processes of yeast manufacture and with problems arising in the manufacture and rectification of potable and industrial spirit. During the past few years, the operations of the company have been extended and their interests broadened considerably, and it was felt that great advantage would accrue from the co-ordination of these more or less individual efforts. The need was felt for providing opportunities for consultation so that the entire resources of the scientific staff would be available for dealing with any problems that may arise. It was decided, therefore, in the first instance to establish a research and advisory centre for biological work and to extend its scope as necessity arose."

One learns with great interest that the company have been considering for some time past the growing importance which the alcohols are assuming, particularly ethanol, as raw material in chemical manufacture. They have been examining this question from a wide angle, not only at home but on the Continent and abroad, and have now definitely decided to enter the field of chemical manufacture. It is their intention to manufacture large quantities of acetic acid, both as vinegar

and as "glacial" acid, to meet the requirements of the home market for acetone, butanol and similar substances manufactured not necessarily by fermentation processes but by catalytic and pressure processes, if such offer greater commercial possibilities. They are at present producing high grade esters and expect before long to manufacture on a large scale a wide range of solvents and plasticisers which will meet the growing demand for these substances in the preparation of cellulose lacquers. These new developments necessitate building and equipping new laboratories and experimental plant houses, and plans for these are already in hand.

Scientific work, of course, plays a large and essential part in the operations and development of such a company, and in this, as in all other industries, its importance promises to increase. There is something peculiarly appropriate—indeed, one might almost say refreshing—in the fact that a long-established firm, whose success has come through supplying old and well matured spirit, should at the present time be bringing into its organisation that new spirit in industry—the application of the most scientific methods and thought. After having walked round the institute as it is to-day, one cannot fail to admire the youthful vigour and far-sightedness with which the company has placed its science upon a proper plane.

The Work of the Institute

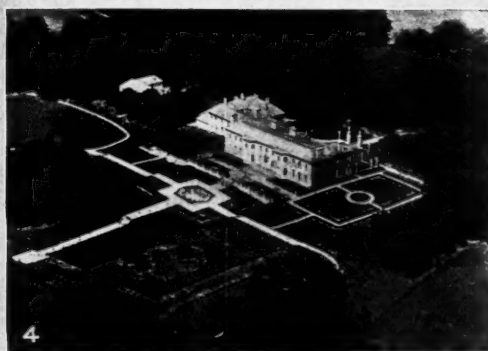
Broadly speaking, the work of the Institute falls into seven sections. Dr. H. A. Auden is in charge of problems connected with raw materials; Mr. T. H. Pope of investigations relating to the production and rectification of potable and other alcohols; Dr. H. B. Hutchinson of the biological work; Mr. E. A. Meyer of yeast investigational work and Mr. A. Olsen of industrial yeast work; whilst Dr. R. Gilmour directs the investigational work in connection with acids and esters, and Mr. F. W. Clark is in charge in so far as the actual production of esters is concerned. Mr. W. A. Davis is responsible for the analytical work both of the department and of the company, and Mr. A. M. Peake is the head of the information bureau, including patents. Each of these officers is provided with a small private room and a well-equipped laboratory in which his assistants work. Altogether there are, at present, about twenty scientifically trained people working at the institute, and this number will undoubtedly be increased as new laboratories and experimental plant houses come into use. Certainly the yeast experimental plant house, with its model bakery attached, both now equipped and ready to come into operation, forms a splendid addition to the original building.

It seems rather a pity that the name of this great concern, The Distillers Company, should convey to people generally the idea that they are interested solely in potable and industrial alcohol. The fact is lost sight of that by far the larger part of the yeast employed in the making of bread all over the country is made and distributed by this firm and its associated companies, and that the good qualities of this yeast depend on the highly scientific work carried on at Great Burgh.

In going through the laboratories, an interesting example was furnished of the unsuspected industrial importance of the work in progress. In one of the yeast laboratories were to be seen the special cultures, each about half a pint of liquid, ready for sending to the various yeast factories. From the yeast contained in one half pint of liquid there is produced during the course of one week at one factory between one and two hundred tons of pressed yeast for distribution to bakers throughout the country.

The library and information bureau is well equipped and well organised. Its main work is to bring together, for the benefit of the company, the private information obtained by reason of its connections with other companies and through individuals in France, Germany, Italy, Switzerland, Belgium, Sweden, the U.S.A., Canada and Australia. In so far as published work is concerned, the scientific and patent journals

Views of the Distillers Co.'s New Research Institute



1. THE LIBRARY. 2, 5 AND 6. LABORATORIES. 3. THE NEW PLANT HOUSE. 4. PHOTOGRAPH FROM THE AIR OF INSTITUTE AND GROUNDS.

and commercial publications the world over seem to be combed for information upon subjects of interest to the company. A summary of such information is issued monthly to the various sections of the Distillers Company and its associated companies. It will be seen, therefore, that the organisation is complete.

The building itself has been adapted to its new use with surprising ease and success. Whether this is due to the accident that the rooms and their disposition happen to lend themselves to such adaptation, or to a rare sense on the part of Dr. Eyre for observing the fitness of things, one cannot say; but if Great Burgh had been built for its present purpose, it could hardly have met the needs more perfectly. The free-

dom from distraction that prevails throughout the institute cannot fail to have its effect on the spirit of the staff; it is the sort of place in which the true research worker may not merely earn a livelihood but find a vocation.

The Distillers Company is to be warmly congratulated, not only from the point of view of the efficiency of its own research service, but as setting a fine example and standard in the proper recognition of science by wealthy corporations. Further, it must be said that the establishment of an institute of this kind must eventually redound to the public benefit. The creation in this country, for the first time, of a centre of biological research directed to industrial ends of itself marks a very considerable advance in our industrial development.

Storage, Packing, Handling and Transport of Chemicals

By an Industrial Chemist

In the following article an industrial chemist who has seen much of the inside operation of large chemical works, discusses the problems of storage, packing, handling and transport of chemicals, and points out the importance in regard not only to safety, but to economy and profits, of the application of the best danger-excluding and labour-saving devices.

THERE are many works which possess highly developed chemical processes, and in which the most careful attention has been given to every phase of manufacturing operations, so that cost of production has been reduced to the lowest possible level, and yet the methods of storage and handling are out of date. It is frequently overlooked that in the aggregate large sums of money are spent upon the handling of materials and products into, through, and out of the plant, and whilst it is perhaps easy to generalise and difficult to particularise, especially in works which have grown up in more or less congested localities, the state of development to which mechanical handling has advanced in recent years makes it almost certain that for every problem there is a solution which will show profit in the end.

Much has been written from time to time in regard to the matters under discussion, and THE CHEMICAL AGE has always been to the front in advancing the claims to attention which storage, packing and general handling problems possess. Special issues, of which the present one is a member, have been replete with definite suggestions, and it is felt best in this introductory article to write in a general fashion. If the attention of chemists be focussed upon the problems and a realisation of the economies possible be engendered, there will be no difficulty in obtaining information upon any special topic—conveyors, handling equipment, special storage facilities wrapping and packing machines, and the like.

In many instances, it will be the duty of the chemist to set the ball rolling and from his knowledge of the nature of his product to attain a general survey of possibilities. The specialist in mechanical plant construction, in container manufacture, and so forth is then at hand with expert information of value.

Storage

The storage of chemicals is an important matter. We need only recall the recent disaster at Hamburg, where the escape of phosgene from its container caused many deaths. It is not many years since even such an apparently inoffensive material as a nitrogenous fertiliser wrecked a whole chemical plant and sent the angel of death abroad through a whole town at Oppau.

The physical and chemical nature of manufactured products or raw materials must then receive much consideration from the point of view of safety. Compressed gases must be kept in cylinders or tank cars of adequate strength, and whilst, on account of much special research into the matter which has been and is still being done, the responsibility of the individual chemist is somewhat shifted, no harm can come of a thorough knowledge of the position.

The storage of inflammable liquids needs the most careful consideration. The payment of large insurance premiums does not end the matter. On at least two occasions the writer has seen rivers of flame caused by the escape of inflammable liquids into waterways, in the one case great damage being done to shipping, and in the other the river of flame

entering and setting fire to buildings well away from the place of leakage.

The transfer of certain inflammable liquids often presents a potential danger spot, for static electricity is often developed, resulting in the formation of electric sparks of sufficient intensity to set fire to the liquid undergoing transfer. Particularised information is available and references will gladly be given.

Suitable storage often means economy, apart from safety. Still thinking of highly volatile liquids, the loss from petrol tanks is large, in time especially, when variations in temperature cause the tank to "breathe." Large stores of "gasoline" in the States have been equipped with types of balloons which inflate with the petrol-laden air that is "breathed out" upon occasions. The absorption of evolved vapours in solid absorbents, and subsequent recovery, is quite an economical proceeding, for inorganic and organic absorbents have now been highly developed.

Where large stores of duty-paid alcohol are kept, it is often a paying proposition to guard against loss by evaporation, which is frequently greater than would be expected.

The conditioning of air—drying it, absolutely or partially—is desirable when large quantities of hygroscopic materials are to be stored. The inorganic gel absorbents afford cheap means of drying air in a very simple fashion.

For the storage of valuable and easily contaminated liquids, such as perfumes, glass-lined tanks and the like are standard equipment. Similarly for the storage of acids and chemicals with corrosive properties, many special types of tanks are available, including those made in corrosion-resisting metals and alloys, chemical stoneware, hard rubber-lined tanks, special composition containers, and so forth. For almost every need in the field of corrosion resistance there is a supply.

Perhaps the storage of coal is not generally practised in chemical works on a large scale, but in case of need it should be remembered that special methods of stacking have been worked out, whereby the danger from spontaneous combustion and the loss in value from less drastic oxidation can be prevented. Here again special information is available.

Whether chemicals are stored in bulk or in packages, it is well to pay some attention to the ease of removal when required. Powdered products such as cement, soda ash, etc., can be housed in special silos from which ready removal by automatic means is ensured. The possibility of caking should not be overlooked and its cause traced and appropriate remedies found.

Pharmaceutical preparations of high purity may often be contaminated as a result of improper packing and storage, and as the onus of responsibility rests upon the producer, the matter should receive every attention.

Even the stacking of barrels or paper packages can be done in a manner to facilitate easy removal or removal of any desired section, and time is not mis-spent in considering even such an apparently simple matter.

Concrete tanks for the storage of oils, mineral and vegetable,

have been shown satisfactory and low in first cost. Such tanks may conveniently be rendered proof against the absorption or leakage of oil by a simple treatment with silicate of soda, which reacts with the lime of set concrete to form a resistant skin.

It would be an impossible task to attempt to catalogue every product or type of product and to indicate methods of storage, and in any case it would be wearisome to the reader. The instances selected may serve to indicate, however, that storage is not to be dismissed without a thought, and that safety and economy may be ensured by attention to the chemical and physical properties of the product or raw material specially of interest to the individual.

Packing and Wrapping

The development in the art and science of mechanical wrapping and packing of chemical and other products has been amazing in recent years. Automatic weighing and recording machines, bag making and filling machines, carton making and filling apparatus, machines for the filling of liquids into bottles or powders into tins, machines for the printing, cutting, and trimming of wrappers and the subsequent wrapping of individual portions of a material or tablets of soap, sweetmeats, and the like, apparatus which removes large bulks of "heavy" materials from storage, weighs and packs them into sacks or other suitable containers, and many other special types of automatic machines have become commonplace in industry, and even if first cost is somewhat high, the saving in labour and materials is so great as to pay off the first cost in a reasonably short period of time.

Here, again, the chemist may well take the first step. He must consider the nature of his product from every point of view.

The nature and the ultimate consumer of a product often determine its package. No producer of coke would dream of sending out his wares wrapped in the hygienic and beautiful Cellophane which is so deservedly popular for packaging many articles. This cellulose product is now being made in this country, and there are many materials—possibly some which are not intended for the individual consumer—which will come to be sent out packed in Cellophane.

Hygroscopic powders which are to remain in warehouses, retail shops, or upon the customer's own shelves, must be packed in water-vapour-resisting containers. Material for making suitable bags and cartons is now available, and hygroscopic powders, etc., packed in such composition paper products may be stored almost indefinitely without caking.

When the product to be packed comes directly into contact with the wrapper, its composition must be studied as well as that of the dyes used in the printing of the maker's name, etc. upon the wrapper.

The general public is becoming more and more critical, and as British producers are renowned for first quality products, no effort should be spared to assist the salesman. The mutual reactions of product and packing should be known.

To invent a device which shall appeal to the user may not be the function of the chemist, but it is not outside his capacity. The captive cap upon the tube of dentifrice, shaving cream, etc., the easily opened tin of boot polish, the sprinkler top of various packages, the readily uncapped bottle, the shaving stick holder which allows the soap to be used with comfort to the last thin disc, the combination pack for face powders and cosmetics, and many other devices have helped sales of already first class products enormously.

For the packing of chemicals in bulk, barrels are not the only means available. Paper sacks, or sacks of other materials, can often be used, and the size of the container may well receive study in the interest of the consumer. Many products are susceptible to the action of light as well as of moisture, etc., but suitable containers are available.

The importance of the "pack" does not end with the manufacturer who makes directly for the public. Beauty, utility, and stability may be achieved with relative ease, and will force their appeal upon the consumer of an ounce or a hundredweight. Economy in packing is so readily realised with the aid of the many machines available, that there seems no excuse whatsoever for the high packing costs which are so often hidden away amongst other charges or considered, if at all, as a necessary evil.

Handling

Reference has already been made to the mechanical handling of materials into, through, and out of the plant, and to the very substantial economies which are possible, especially when labour charges are high. In the design of a new factory it is certainly easier to allow for the installation of such plant, and modern chemical engineers are sufficiently alive to the importance of the question. It cannot be too strongly emphasised, however, that even in works which have "just grown" it is possible to instal handling devices of one or another type, and if the initiative be taken, competent advice is available, and specialists in mechanical handling appliance construction are able most often to present, if not theoretically the best, at least an economic solution of internal transport problems.

It is clearly impossible in this article to deal with the many types of band and belt conveyors, grab buckets, elevators, telfers, hoists, loading and unloading devices, pneumatic, and many other types of handling apparatus, but it must be noted that powdered, crystal, viscous, corrosive, liquid, light, bulky, fragile, abrasive, hot materials, etc., can be safely trusted to some form of modern mechanical handling device.

The advantages of mechanical handling may be concisely summed up as follows:—

1. Process charges are often reduced by reason of greater facility of presentation of materials where required.

2. Labour charges are reduced—a very evident point—and the saving in this regard is far greater than interest and depreciation charges upon the necessary equipment.

3. A saving in floor space may result in the freeing of expensive plant space for other purposes. In factories situated in congested areas where rates, etc., are high, this may be a very large factor.

4. Many works which supply products for the individual consumer adopt the practice of opening the works for inspection at regular intervals. The effect of smoothly working handling devices is not small upon a public which likes to see the wheels go round and which perhaps appreciates this type of advance rather more than the intricacies of chemical production and control which are less comprehensible.

Even a shorter summary of the advantages of mechanical handling devices may be made in the words "cost reduction." This is no idle fantasy, as has been proved in countless instances. The survey of possibilities made, expert advice taken, and the contract placed—the result in the balance sheet may be expected with confidence.

Transport

When the product has passed out of the works its transport to its destination is still to be considered. The method of transport is a matter which is readily determined, and naturally consideration is given to the nature of the product and the precautions and regulations which have to be observed. Road transport in one's own vehicles may not be so bound up in regulations as is rail transport, but there is a duty to the public in the carriage of dangerous goods.

The chemist need not ordinarily concern himself with questions of transport, but a general interest in the matter, including some knowledge of its cost, is worth possessing.

Many chemists will possibly disagree with the general attitude taken in this article. The questions of storage, packing, handling and transport come under works management and are not strictly within the province of a chemist who has more important work to do. A chemist is engaged as a chemist, it is true, but in business it is the concern of every one to help profits. If, in addition to following his profession enthusiastically and efficiently, the chemist can enter upon other matters which also mean money, so much the better. His advice is often essential in planning handling schemes, and in a general way he is brought into contact with the world's work. The writer is proud of his profession and would scorn to belittle it. The chemical and allied industries—and this is coming to mean the greater part of all industry—can most effectively be managed by chemists. To this end, too strict an interpretation of the duties of the chemist cannot be allowed. Let him concern himself more, then, with the storage, packing, handling, and transport of the almost infinite variety of commodities which chemical science and industry between them produce.

Old and New Methods of Heavy Acid Transport

By "Chemical Engineer"

A REVIEW of the methods of packing heavy chemicals during the last thirty years cannot be other than interesting, not only because it affords an idea of the advances which have been made, but because it reveals that the risks hitherto incurred have been reduced to a minimum, and at the same time considerable economy in transport costs has been effected.

In the industrial districts of the north thirty years ago the 96 per cent. sulphuric acid, known then as D.O.V., was invariably delivered to the mills and dye houses in carboys. The normal load for a wagon, horse and man, was twelve, and that for a wagon, two horses and man, was twenty-four. Eighteen carboys were accommodated on the wagon, and there were six "toppers," that is, carboys placed on top of the bottom tier.

Thirty years ago carboys could be purchased, packed, ready for filling, at 2s. 6d. each. Carboys in those days were made by Burdin and Co., of Castleford. A horse, wagon and teamer, could be hired for 8s. per day, and a wagon, two horses and teamer, could be had for 12s. per day.

When an amalgamation of several of the important dye works was effected, and the Bradford Dyers' Association came into being, their demands were such as to warrant the consideration of new methods of delivering sulphuric acid. Hitherto, they had always been accustomed to use D.O.V. (96% H_2SO_4), and in the process of indigo and other dyeing the acid was diluted. It was soon realised that there was no necessity for resorting to what, in those days, was a somewhat expensive operation, namely, the concentration of sulphuric acid, either in glass retorts or in the Webb's type of concentrator. After all, purity rather than strength was the desideratum.

With the increasing use of spent oxide, and the adoption of a special type of hand-operated spent oxide burner, it was possible to produce chamber acid which was water-white, and this property could be maintained, even after concentration to 80% H_2SO_4 in lead concentrating pans.

Use of Tank Wagons Begun

B.O.V.—pan acid—largely displaced D.O.V., which had hitherto been used, and instead of using carboys for the delivery of the pan acid, road tank wagons were employed. In order to admit of their use, lead-lined acid storage tanks were provided at the mills and dye houses. These were equipped with a suitable cover, and with a plug and seat arrangement. A Cortin's valve was also provided. The storage tanks were so placed as to allow them to be filled easily from steel road tanks having a capacity of about 45 cwt.

This was an important advance, not only because breakages of carboys were eliminated, but the method of handling the acid was free from a good deal of risk which previously existed, and 45 cwt. of acid could be transported at the same cost as 35 cwt. The interest and depreciation on the storage tanks did not represent more than 35s. per year.

In those days hydrochloric acid was transported in carboys, and usually 36 constituted a load, drawn by two horses. The loading of the carboys to the drays and their discharge from the drays were always attended with risk. Similarly, nitric acid was invariably delivered in carboys, and breakages, in some cases with serious consequences, occurred from time to time.

To-day sulphuric acid, both B.O.V. and D.O.V., can be conveyed in either drums of about 8 cwt. capacity or special steel tanks fixed on the platform of suitable motor lorries, in lots of 3, 4 or 5 tons, or by railway tank wagons in 10, 15 or 20 ton consignments. Moreover, either quality of acid can be transported on the canal or river in 20, 40 or 60 ton loads.

In some cases barge tanks are specially built; in other cases the beam of an ordinary barge is removed, and a steel tank is placed on pitch pine cradles fixed to the ceiling of the barge. The acid is usually fed by gravity to the tank in the barge. Fixed on board are an acid pump and motor for discharging the acid to any suitable point on the works where it has to be delivered.

In some cases motor tank wagons are specially provided for the conveyance of sulphuric acid, and usually the motor

of the lorry is so arranged that it can be coupled by a belt to a centrifugal pump, suitably accommodated on the lorry, and the acid can be pumped to overhead tanks on the premises of clients.

Rapid as has been the advance in the transport of sulphuric acid, the improvements introduced in the last few years in the conveyance of hydrochloric acid have certainly been more marked.

There was little to recommend the use of the glass carboy in this country, or its counterpart—the earthenware bottle—largely used on the Continent. Bulk handling was obviously a necessity, and latterly such a system has been adopted by most of the important users of hydrochloric acid in this country and on the Continent.

Motor tank wagons provided with a steel tank and lined with india-rubber or ebonite are now used. Railway tank wagons are also being built for the conveyance of consignments of 10, 15 and 20 tons of hydrochloric acid. Some of these tanks are ebonite-lined; others are lined with a special rubber. Where delivery by motor tank wagons or railway is arranged, an essential concomitant of such transport is storage in bulk.

Storing Hydrochloric Acid

Storage tanks for hydrochloric acid are made in varying diameters and heights, to suit special requirements. The wood employed is usually 3 in. yellow pine. The staves are supported by $\frac{3}{4}$ in. wrought iron circular bands, provided with adjustable lugs which fit close to the staves, and prevent the ends of the bands being forced into the sides. A suitable cover, usually octagonal in shape, is provided to protect the contents from the weather and to obviate the escape of fumes. Both the outside of the tanks and the iron bands and lugs are painted with a special black varnish made of coal tar pitch and creosote. The lining consists of an acid-proof grey rubber mixture, $\frac{3}{32}$ in. thick. To obtain perfect adhesion to the wood, the inside of the tank must be true, and free from ridges and other irregularities. A backing composed of strong rubber-impregnated fabric is first applied. Following vulcanisation, the sheets of rubber are then rolled on to the fabric named, and the pressure and heat maintained until the adhesion is complete. The seams of the lining are covered with broad rubber strips, and sharp bends are avoided. No breaks in the lining for acid pipes are permitted, inasmuch as distribution is effected by syphons. These tanks give admirable service, and, in conjunction with motor tank and railway tank wagons, have revolutionised the transport of hydrochloric acid.

What is now required is some suitable tank for the conveyance of nitric acid. It is true that this problem has received careful consideration in the past, but as yet nothing completely satisfactory has been evolved. Probably before long trials will be made of tanks made of a nitric acid-resisting metal.

Both "Staybrite" and "Anka" should be suitable materials for this purpose. "Anka" in its softest form has a tensile strength of 40-45 tons per square inch, and is extraordinarily ductile. It is an austenitic steel, and therefore cannot be hardened by punching, but it may be hardened, like other metals, by cold work. It is available in all the usual commercial forms in which steel is supplied. It is machinable, and may be riveted with fair ease. It can be soldered, brazed, or welded more readily than most other forms of stainless steel. Its resistant properties to the attack of nitric acid are well known. This material or "Staybrite" should prove a satisfactory material for the construction of an acid tank wagon for the conveyance of nitric acid.

Lord Melchett Elected to the Royal Society

LORD MELCHETT, chairman of Imperial Chemical Industries, and Sir William Symington McCormick, chairman of the Advisory Council of the Department of Scientific and Industrial Research, have been elected Fellows of the Royal Society. Among a number of foreign members elected are Professor Richard Willstätter, of Munich, and Professor Paul Langevin, of Paris.

Plant and Apparatus for Packing and Transport

Notes on Some British Products

The notes appearing below will, it is hoped, be of some assistance to those engaged in the task of packing and transporting chemicals of various kinds. Additional interest is lent to these notes by the account given of the methods adopted by various firms for dealing with substances the handling of which usually gives rise to difficulties.

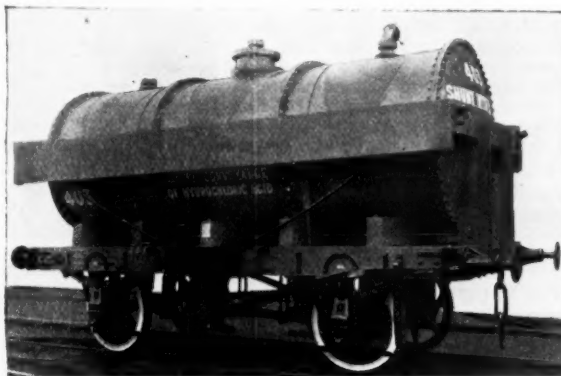
Transport of Chemicals by Rail

THE past ten years have brought a great increase in the number of special designs of railway tank wagons for carrying special chemicals, and particularly in the case of hydrochloric and nitric acids. For many years it has been customary to carry commercial or concentrated sulphuric acid in railway tank wagons in plain iron or steel barrels, with satisfactory results.

As long ago as 1900, Charles Roberts and Company, Ltd., of Horbury Junction, brought out a design and actually built tank wagons of this type, although it was not until 1913 that the Railway Clearing House adopted such drawings and published a standard specification. Since that date there has been very little alteration in the design. It is customary to fill the tanks by gravity through the manhole, and to empty through a 2 in. double arm outlet which discharges on either side over the solebar. There are specifications for tank wagons of either 10, 12, 14 or 20 tons capacity.

Similar types of tank wagons have been used for the conveyance of caustic soda and pure ammonia. The conveyance of dilute sulphuric acid presents far more serious problems. Here, of course, plain iron and steel barrels cannot be used, and the method chiefly employed hitherto has been to line such barrels with lead in sheets. This lining may be applied in two ways, either by what is known as the homogeneous method whereby the lining is sweated on to the actual

type described above. These proving unsatisfactory, an attempt was made, with more success, to build some special wagons in which were placed six large glazed earthenware re-



HYDROCHLORIC ACID TANK.

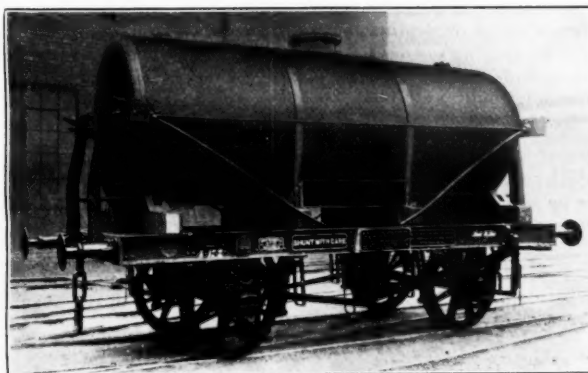
ceptacles, each containing approximately 220 gallons of acid. Difficulty, however, was experienced owing to the heavy shunting which the vehicles had to withstand.

The company therefore brought out in 1918 a design of vehicle having the barrel made in three parts and lined throughout with ebonite by the New Eccles Rubber Works, Ltd. This design has since proved remarkably satisfactory, and although the design of barrel has since been modified to facilitate the process of lining and to give increased capacity up to 14 and even 20 tons, the principles of the design remain unchanged, and have the full approval of the Railway Clearing House. The railway companies insist that the tank should be discharged by syphoning out from the top of the vehicle, and no bottom outlet is incorporated.

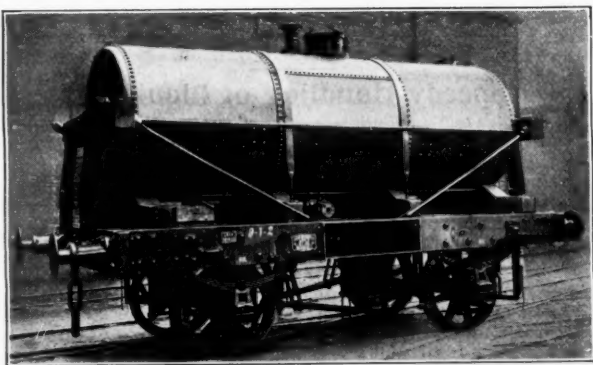
A particularly commendable feature of this design is that an electrical test very readily shows the presence of any breakdown in the ebonite. The success of these vehicles depends, of course, largely on the form of ebonite lining, which is especially designed to withstand, not only shunting shocks, but also the expansion and contraction of the barrel, whilst it retains the essential property of keeping the acid water white.

Nitric Acid

The same firm have also brought out designs of tank wagons for carrying nitric acid. In this case the barrels may be built either of stainless steel or of aluminium of a guaranteed purity not less than 99.5 per cent.



NITRIC ACID TANK.



SULPHURIC ACID TANK.

barrel plates, or, alternatively, the sheets may be secured in position by lead covered steel straps. The homogeneous method is to be preferred, but, in any case, very careful workmanship is essential, as if the lining becomes loose endless trouble is bound to result.

Hydrochloric Acid

The conveyance of hydrochloric acid has called for a very specialised design of tank wagon. The inevitable loss through breakage of carboys, and consequent damage to vehicles carrying them, has led users for many years to search for a method of carrying this liquid satisfactorily in tank wagons in bulk.

The first attempts took the form of multiple barrels of wood with double sides, the outer and inner casings being separated by a layer of pitch and sand, and further lined with tongued and grooved boards impregnated with paraffin wax. These have been followed by various attempts to line tank wagons with soft rubber, with varying degrees of success, but a real solution of the problem has been provided by the special design of ebonite-lined tank wagon such as those brought out by Charles Roberts and Co.

As long ago as 1907 this firm built a number of the wooden

These designs are approved by the Railway Clearing House, and a considerable number of the stainless steel tanks have already been built. With the present price of stainless steel, the aluminium tank wagons are rather cheaper, but special precautions have to be taken in the case of the aluminium tanks to prevent undue wear upon any part of the barrel where the material is, of course, comparatively soft.

In this case again, it is usual to discharge the acid by syphonage, without any bottom outlet, and this method of discharge has been incorporated in the standard designs.

Chlorine

During the war Charles Roberts and Co. designed a special type of tank wagon for conveying liquid chlorine. This liquid, of course, was carried under a considerable pressure, and special electric-welded steel barrels were employed, the barrel then being encased in a special wooden housing to prevent any corrosion weakening the strength of the plates.

Although there is now, fortunately, no call for chlorine gas for its original purpose, there is still a demand for this type of tank wagon for modern processes. In addition, other chemicals such as ammonia liquor and coal and petroleum by-products are carried in the standard type of tank wagons.

Owing to the extremely corrosive nature of many of the liquids above referred to, and the great risk of very serious damage to property and even to life which would occur if there were any breakdown of the containers, there is no need to stress the great necessity of seeing that these are made by firms who thoroughly understand what is required, whilst the Railway Clearing House authorities have many regulations, with all of which it is necessary to comply strictly.

Heavy Corrosive Acids

In storing and packing heavy corrosive acids, the main points to be considered are the resistance to corrosion and the resistance to rough handling of the vessels used in packing. As regards the storage vessels, only resistance to corrosion need be considered, assuming sufficient strength to withstand the weight of material contained. When dealing with packages for transport, the strength of the container (as vessels will receive a good deal of rough handling) is almost of more importance than its resistance to corrosion, for vessels can nearly always be suitably lined. By courtesy of Spencer Chapman and Messel, Ltd., a tour of inspection was made of their works, and the following points of interest to packers of acids were indicated.

Sulphuric Acid

The chamber acid, of strength up to 70 per cent., is stored in the lead chambers. After concentration, however, and at strengths varying from 78 to 96 per cent., the acid is elevated under pressure to steel storage tanks, which are, in fact, old boiler drums with the tubes removed and the holes carefully patched. The capacity of these is from 50 to 60 tons each, and as was pointed out, the containers must be reasonably strong.

These storage vessels are usually raised some height above the ground, and the acid is run off from them by gravity into packages for transport. The usual methods of packing are steel drums, of 10 to 14 gauge mild steel, tested to 40 lb. per sq. in.; railway tank wagons, and road tank wagons. In the case of the railway tank wagons the acid may either be drawn off at its destination from the bottom of the tank, or, if the consumer possesses an air compressor, it may be elevated by compressed air to the receiver. The railway wagons are specially built and hold about 10 tons. The procedure is similar in the case of road wagons, which have an air compressor fixed on the chassis and driven from the engine for elevating the acid. Carboys are generally used for local work. With regard to bulk methods of transport, the road was stated to be much quicker than railway. Steel drums of 5 to 10 cwt. capacity are also used for sulphuric acid of high concentration. Oleum is also stored in steel boiler drums, and is packed in mild steel drums of about 2 cwt. capacity, which have provision for removing the acid either by drawing off or by evacuation. Sulphuric acid is on the whole the easiest of the heavy acids to handle.

Hydrochloric Acid

Hydrochloric acid is more difficult to deal with. When it comes from the towers, it is run into storage tanks of York-

shire flagstone, and from these it is run off into carboys. The purer qualities of acid are stored in rubber-lined tanks, some of these having been in use at the works for several years. As steel is not resistant to hydrochloric acid, some trouble must be taken in considering a suitable form of packing. Railway tank wagons and road tank wagons are usually lined with ebonite. Spencer Chapman and Messel, Ltd., have experimented with linings of pure rubber, and drums lined with this material have proved satisfactory. Apart from its resistance to corrosion, rubber has the advantage that it can adapt itself within reasonable limits to new contours of dents caused by rough handling. This form of container has been subjected to extremely hard usage, such as would be met with only in the roughest conditions of transport, and, as a result, the drums have proved perfectly satisfactory.

Nitric and Nitration Acids

Nitric acid is packed in carboys when dealing with acids up to 70 per cent. For export, acid-resistant stoneware jars are used, packed in wooden cases, the interstices being filled with whiting. Carboys, when used, have been dipped in a solution of sodium silicate or sulphate of soda to render the straw packing fireproof. With acid of strength greater than 70 per cent., great care must be taken, and for strength 70 to 90 per cent. aluminium-lined steel drums have proved successful. Mixtures of nitric and sulphuric acids for nitration purposes are packed in steel drums, as in the case of sulphuric acid. Another method of transporting sulphuric acid in bulk is by tank barges, holding about 50 tons of acid. For export purposes, quantities of pure acids of all types are packed in Winchester.

As nitric and hydrochloric acids are the more difficult to pack in steel vessels, it may be thought that steel of the nickel-chromium type could be used. This steel is, however, scarcely resistant at all to hydrochloric acid. It is quite suitable for nitric acid, but the price is high for this purpose, being many times more than that of mild steel. We understand that experiments are in progress with a view to lining ordinary steel drums with a thin layer of this acid-resisting steel, and so rendering the price a commercial proposition.

Speedy Handling of Liquids

A RAPID method of handling methylated spirits is practised at the new works at Hammersmith of the Methylating Co., Ltd., which has been designed with this end in view. Denatured spirit is stored in large tanks of four to six thousand gallons capacity, in an upper storey, having been pumped into these tanks from the mixing tanks situated in the basement. The tanks are labelled according to whether they contain mineralised, pyridinised, or industrial spirit, and are connected by coloured pipes to the measuring and filling plant in the filling department on the floor below. The apparatus measures out the correct amount of spirit and delivers it into cans or drums, which when full are pulled from under the nozzles and pushed on one side for sealing and labelling. Lorries can pull right up to the side of the filling department, which is raised some six feet from the ground and cans and drums can easily be loaded. For filling tank wagons there are in the storage room two large measuring tanks of 1,000 and 500 gallons capacity, whence the spirit can be pumped through a hose directly into wagons standing in the yard outside. Nearly all containers for the spirit are steel drums or cans, wooden casks being but rarely used, although the firm keeps such containers in the event of orders for spirit packed in this way. The usual capacities are cans of 5 and 10 gallons, and drums of 50 gallons, 80-90 gallons, and 100 gallons. For export, 5 and 10 gallon cans with flat tops (to economise as much space as possible) are used, while special one gallon cans are also employed. The latter are stoppered with a cork sealed with a metal seal to prevent loss of spirit, and are packed ten at a time in a strong hooped wooden crate. This is a very convenient method of packing, as all available space is utilised. Filling is done, of course, under Customs supervision. Cans with conical tops are used for the home trade and all metal containers, except the one gallon cans, are sealed with screw-down metal caps. A small amount of spirit is put into bottles of about a quart or two quarts capacity, but the call for these is not great, as large buyers usually do their own bottling.

The works is laid out with the object of facilitating speed

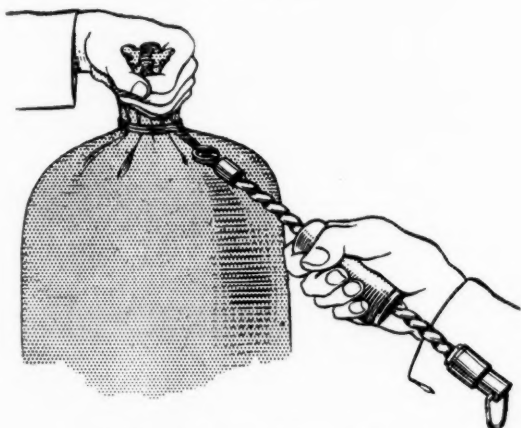
in handling spirit, the storage department being situated, as mentioned, over the filling department, which in turn is easily accessible to transport vehicles.

Bagging Powdered Materials

In dealing with powdered materials, sacks form a convenient and inexpensive method of packing, providing, of course, that they are not liable to deterioration from the contents. If access to both a railway siding and to a river is available, the packing department may be arranged between the two, in the form of a shed, with a reversible belt conveyor traversing it, as is the practice in a London chemical works. Sacks are placed on an automatic weighing machine under the mouth of a hopper, and the required amount of material is run in. Sacks are passed on to be sewn up and labelled, and put on to the conveyor for removal to barge, ship or truck. When dealing with fine dry materials the sacks frequently need a safety stitch to be put in round the seams to prevent loss of material.

Safety Seals for Sacks and Boxes

AMONG the points that must be faced by the packing departments of all manufacturers and merchants are those of getting work done quickly, making packages strong enough to stand rough handling, and the prevention of pilfering in transport. Two devices which have been designed to give help in this direction are known as the "Speedo" box strapping and sealing machine and the "Speedo" double wire tyer which are marketed by Seals, Ltd., of 53-54, Chancery Lane, London. The "Speedo" double wire sack tyer is a novel and ingenious method of tying sacks. This device has been tested and adopted by a large number of the leading chemical manufacturers. By using it, a sack can be tied in two or three seconds, and the double wire which is used for the tie gives great strength, and is most efficient. Practically any size bag or sack can be tied by this means, as wires from 4 in. to 12 in., going up in half-inches, can be supplied. The action of the device will be gathered from the illustration. A sack tied by this method cannot be undone and the wire replaced exactly as before, hence pilferage is effectively stopped.



THE "SPEEDO" BAG TYER.

The old method of securing cases by nailing on hoop iron, or tying with rope, is now being replaced in the modern up-to-date packing departments by a small hand machine. This machine will place a band of steel hooping around a packing case or box and seal the ends of this hooping in 20 seconds. No nails are required in the hooping, as the machine pulls the hooping so tightly around the case that the hooping embeds itself into the corners, and when the ends are sealed, it becomes practically an endless steel hoop, which reinforces the case so as to make it appreciably stronger. As the hoops cannot be taken off without being cut, pilfering is entirely abolished. The makers of the machine will be pleased to send one on free loan for trial, together with a free supply of seals and hooping, to any firm that may be interested.

Electrically Welded Barrels and Drums

SPECIAL attention has been paid to barrels and drums for chemical purposes by the Steel Barrel Co., Ltd., of Uxbridge. Their type "Q" drum is made in a large range of sizes, the 45 gallon light drum of 16 B.G. material being always kept in stock. For the conveyance of inflammable liquids the "R" type is recommended, but having reinforced pressed-out rolling hoops it cannot be used for any liquids which have to be measured by Customs and Excise authorities. It has, of course, been passed by the Railway Clearing House



authorities. Although not used for all purposes, the barrel has certain advantages over drums with rolling hoops, in that it can be easily handled and the transport costs are lower owing to less weight. For oil and petrol it is almost exclusively used. Other drums include type "X," a light non-returnable drum for paints and varnish; the type "Q.C.," suitable for many journeys, and which, although not made to Railway Specifications, is suitable for the conveyance of inflammable liquids. Drums made by the company are specially strengthened at the chimbs, and joints are electrically welded throughout.

Export Tanks for Chemicals

ONE of the main points facing the exporter is the problem of how to utilise transport space to the best advantage. With round barrels or drums this is always a matter of difficulty owing to the space between them, so that, therefore, square tanks are more economical for shipping abroad. G. A. Harvey and Co. (London), Ltd., of Woolwich Road, London, manufacture a special line of mild steel closed-top export tanks. They are closely riveted and are made either with a 14-in. cast iron manhole or with bolted tops. The capacities range from 50 gallons to 600 gallons. Another type of tank produced by this company, which has a wide experience of sheet metal products, is the underground mild steel storage tank. This is of a cylindrical pattern, welded throughout. It can be supplied galvanised after manufacture, or painted with anti-corrosive paint. An important branch of the firm's activities is the production of pneumatic collection and conveying installations, and woven wire for sifting fine chemicals is produced in various gauges.

Three-Ply Wooden Barrels

BARRELS constructed of three-ply Venesta birch, with bodies made in two pieces (except barrels under 10 inches diameter which are made in one piece), are supplied by Venesta, Ltd., of 1, Great Tower Street, London. All body bands are one-ply beech, 2 inches wide. The heads and bottoms of barrels are of three-ply Venesta birch in one piece. In the larger sizes, and when necessary for extra strength, as in the case of export, deal crossbars are fixed to the top and bottom. Barrels can also be further strengthened by the addition of hoop iron bands top and bottom. For aniline dyes or fine powders, a special pattern is suitable, with strips of cardboard fixed over joints on the inside, and with cotton packing fitted round top and bottom. Barrels can also be supplied with linings if required. In the "J" pattern the vertical joint is made with metal strips riveted on the outside, while in pattern "K" it is made with strips of "Venesta" riveted on the inside.

The barrels are made in a large number of standard sizes, varying from an inside diameter of 8 inches with an outside

depth of 11 inches (capacity 452 cubic inches) to an inside diameter of 16 inches with an outside depth of 22 inches (capacity 13,518 cubic inches). Among the materials packed in these barrels are aniline dyes, borax, ammonium carbonate, chemical manures, cream of tartar, dry colours, saltpetre, soda, copper sulphate, sulphur, yellow ochre, etc. In addition to these barrels, the firm manufactures returnable cases for the home trade; packing cases for export; factory and van trays; warehouse, mill, and factory skips; carriers for warehouse and factory; parcel post boxes; as well as collapsible metal tubes and foils.

Cast and Wrought Iron Tanks

CAST and wrought iron storage tanks from 10 to 18,000 gallons capacity; steam and air receivers; steel chimneys; piping for steam, gas and fluids; wire ropes, fencing, etc.; steam mountings; pumps—all these and numerous other important

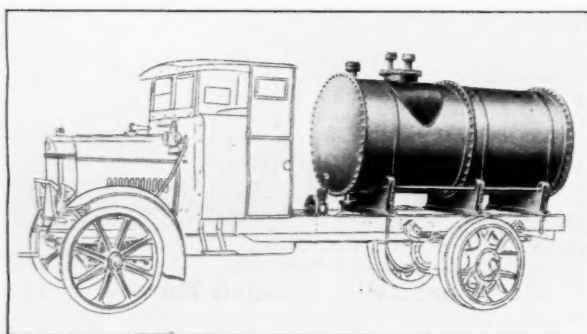


A PRESSURE RECEIVER.

industrial products are made by Thos. W. Ward, of Albion Works, Sheffield. The pressure receivers (of which one is illustrated) are made from steam drums from Babcock and Wilcox boilers. They are hydraulically tested to 300 lb. per square inch.

Lined Tank Vehicles

TANKS for various types of motor chassis, designed to resist corrosion by acids, alkalis and other corrosive liquids, are manufactured by Thompson Brothers (Bilston), Ltd., of Bilston, Staffs. Special tanks are also supplied for use when liquids are to be carried, and to be kept free from contamination. The illustration shows a tank wagon constructed recently for the carriage of acid to the order of a large firm of chemical manufacturers.

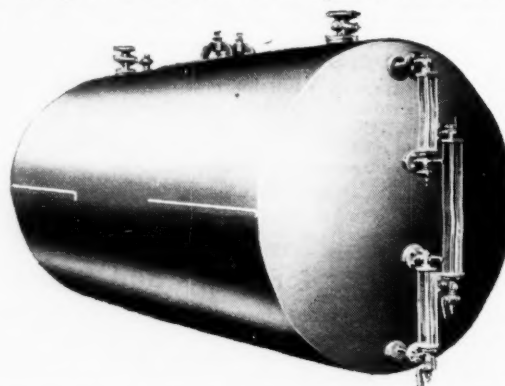


AN ACID TANK WAGON,

The cylindrical acid tank is 4 ft. 3 in. in diameter by 10 ft. 7 in. long, having a useful capacity of 800 gallons. Internally an ebonite lining is extended to form a protective apron around the manhole. The contents are discharged by means of an air compressor driven by the vehicle's power unit, and complete drainage is ensured by means of a sump welded to the bottom of the tank. All connections on the tank and the tank itself are welded throughout and designed for a working pressure of 30 lb. per square inch. The mounting is arranged by means of hardwood bolsters, with straps around the tank. Thompson Brothers are known not only for their tank wagons but also for stationary tanks for storage purposes, of which a wide range is available.

Welded Steel Tanks

FOR 72 years (since 1856) R. Jenkins and Co., Ltd., of Rotherham, have made welded tanks. They serve the chemical and artificial silk industries among others, manufacturing tanks and containers of any capacity, in welded steel, to customers' own specifications. Those too large for transport are welded up on site. Among the uses of these tanks are the storage of cellulose, carbon disulphide, benzol, and many



A CAUSTIC SODA TANK, 11 FT. 6 IN. BY 6 FT., TESTED TO 84 LBS

other liquids. Other products made include tanks, pans, troughs, etc., with heating coils in steel, copper, and aluminium, if necessary with steam-jacketed sides and bottom, or part jacketed only. The storage tanks built may be cylindrical, rectangular, or to suit an irregular site and to hold from 4 gallons upwards. Some idea of the range of sizes is given by the cylindrical tanks supplied for petrol storage, which may be obtained in sizes holding from 100 to 30,000 gallons.

Light Steel Drums and Kegs

LIGHT steel drums and kegs—4 in. high by 4 in. diameter to 42 in. high by 22 in. diameter, 26 gauge to 18 gauge—in black steel, lead-coated, steel, galvanised or tinned, are produced by Todd Bros., of Widnes. These kegs and drums may be with double seamed, hooped or welded ends, and folded or welded longitudinal seams. Various sizes and styles of lids are supplied according to the purpose required, and bodies are corrugated, beaded or plain as needed. For stiff paints, greases and materials of this nature the sizes run from 4 in. by 4 in. up to about 16 in. by 24 in., being made generally from black steel. For oils, etc., sizes range from 1/2 gallon to 15 gallons, made from lead-coated sheets, having soldered end and side seams, ends double seamed on or hooped, head fitted with neck 2 in. to 4 in. diameter for cork bung, or with metal screw bung. Both the above styles are also supplied in welded drums, where they are needed to stand severe handling in shipment or transportation.

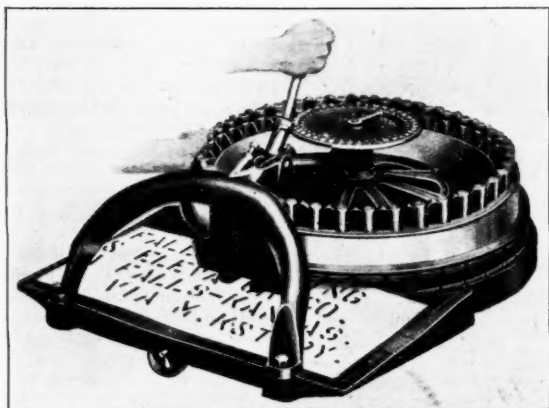
For solid and powdered chemicals such as caustic soda, cement, lime, drums up to 42 in. by 22 in. diameter are called for, being made with plain or corrugated bodies, folded side seams and double seamed ends, the lids usually being of the push-in lever type, having suitably flanged lids. These lids can be expanded after the drum is packed, or be fitted with clips on the drum top to swivel round or to solder to lid. For dye powders and the more important and expensive materials, it is wise to have a somewhat better drum, having rather stronger material used in the manufacture, and with the side and end seams suitably prepared in a special manner to prevent leakage through blowing. These drums are supplied up to 42 in. by 22 in. size, and are fitted with the lever lids mentioned above or more generally with one of the special lids supplied for this trade. For this trade there is a screw lid 8 in. in diameter, and also a 9 in. inverted lid with cotton packing and four or eight swivelling clips. For ores, etc., kegs are used, having riveted or double seamed bottoms with removable head fastened with nibs and clips. Sizes run up to about 19 in. by 12 in. diameter.

Special attention may be drawn to the steel drums with

8 in. screw lids. No tools are required to fit the lids. They are specially suitable for material in powder or crystal form, the lids being easily and quickly fitted. Two studs are attached to the lid to allow a flat piece of wood or iron to be used as a lever to screw and unscrew the lid, the saving in time in making up the drum for despatch being a great factor in (a) reducing the overall cost of the package, and (b) avoiding any congestion in filling arrangements and delay in despatching. The screwed opening in the top of the drum projects outwards to allow the contents to be completely emptied.

Marking Bags, Cases and Containers

PROBABLY no detail calls for more attention than the labelling of packages containing chemicals, so as to show clearly contents, weight, destination and the makers' name. Where sacks, cases, or barrels are to be dealt with, stencilling the required information is one of the quickest methods, and provided the stencils are well cut, one of the most legible that can be employed. There is, however, a disadvantage that is encountered when using metal stencils, namely, that of their rigidity, and the delay in getting them cut. Oilboard stencils, as used in the Diagram, are more satisfactory in this respect, as they can be used on uneven surfaces, a great advantage. The Diagram is a labour saving machine for cutting stencils, and greatly simplifies the marking of cases, drums, barrels, bales, parcels, steel work, etc. The machine, supplied by the Diagram Stencil Machine Co., Ltd., of Upper



THE DIAGRAM STENCIL CUTTER.

Thames Street, London, E.C.4, works on the principle of an embossing machine such as will be found at many railway stations. The punches and dies are arranged round a circle. On pressing a lever the punch descends and cuts the oilboard, which is moved forward by means of automatic spacing mechanism. The punches and dies remain sharp as long as the machine is not used for cutting metal. An average address can be cut in one minute. Marking is done by means of waterproof ink, which is supplied by the makers, and which, incidentally acts as a preservative on the oil cards, thereby greatly adding to their useful life. The machine is compact and strong. Among the firms using the Diagram are the Anglo-Persian Oil Co., Ltd., Bell's United Asbestos Co., Ltd., Boot's Pure Drug Co., Ltd., the British Dyestuffs Corporation Ltd., the Cassel Cyanide Co., Ltd., Dorman Long and Co., Ltd., the Graesser Monsanto Chemical Works, Ltd., Hadfields, (Merton), Ltd., Pilkington Brothers, Ltd., Reckitt and Sons, Ltd., and the United Glass Bottle Manufacturers, Ltd.

The Manufacture of Metal Containers

WHILE many firms buy ready-made drums and containers for chemicals, there are some large works which prefer to instal plant for the manufacture of drums on the spot. A great variety of machinery for sheet metal work of this kind is made by Moon Brothers, of 125, High Holborn, successors to F. E. Adams Pressure Tool Co., Ltd. For pressing the ends of drums for caustic soda, paints, oils, etc., the No. 4 double-sided power press, model PDS, is extensively used.

When the purchase of a press is considered it should be remembered that as the total cost of various dies probably exceeds the cost of the press, it is essential that the press be well constructed. In the press under consideration the body, ram, and guides are made of iron of a quality satisfying the Government test of 9 tons per sq. in., and all important forgings are made from Siemens-Martin steel. The press occupies a space of 50 in. square.

The P.C.M. corrugating machine is specially applicable for corrugating drums for use in the oil, paint, and alkali trades, and is capable of dealing with drums with a maximum diameter of 30 in.; it is used wherever it is desired to add to the strength of a drum without adding to its weight. A floor space of six by two and a half feet is occupied. For forming the side seams of bodies preparatory to folding, a high speed power folding machine is available. Bodies of kegs can be folded two at a time. An automatic grooving press is made for closing the seams. Two models are available, one for drums of a maximum length of 36 in., and the other for those with a maximum length of 42 in. The minimum diameter that can be handled in each case is 7 and 8 in. Among the numerous types of machines included in the firm's range are drum body flanging machines, various types of box-making machines, and a large number of seaming machines. A special machine is made for labelling cans.

Gravity and Other Conveyors

GRAVITY and power operated conveyors for a variety of purposes are made by W. and C. Pantin, of 147, Upper Thames Street, London. In the main, the gravity conveyors are of the roller type, in which a series of closely spaced rollers or ball bearings are fitted in an inclined frame, and they may be used to handle almost any type of package with a minimum of attention. Since they may be fixed overhead, a large area of floor space can be saved, which would otherwise be occupied by trucks. These conveyors are made either in an extended form or in spirals, and can, naturally, only be used for transporting goods to a level lower than the starting point.

Where long-distance work is to be done, gravity conveyors can be used in conjunction with power elevators. The elevators are situated at the lower end of the conveyor, and lift goods to the top of the next conveyor. Friction spiral shoots are designed for all classes of goods. When passing through several floors they can be made to receive goods from or deliver goods to any floor of the building. Heavy duty roller conveyors are suitable for heavy goods such as ingots and castings. Another type of conveyor is the wheel conveyor, possessing two lines of wheels, which is suitable for light articles, but of course it cannot be used for articles of less than a minimum width. Breakable articles can be conveyed on band conveyors. Apart from gravity and power operated inclined conveyors, various types of horizontal power conveyors are made by the firm, which also includes in its range numerous portable band, slot, and bucket conveyors.

Steel Cylinders for Compressed Gases

SINCE its inception the Chesterfield Tube Co., Ltd., has manufactured, amongst other products, seamless steel cylinders for the storage of compressed gases, and the company now regularly supplies most of the important consumers at home and abroad. The cylinders are entirely weldless in construction, being produced from a solid billet of steel by means of piercing, hot and cold drawing, and necking operations. Cylinders are manufactured in accordance with the specifications to comply with the recommendations of the Gas Cylinders Research Committee, 1921; the recommendations of the Parliamentary Committee, 1895, which also conform with the specifications in the British Railway Regulations; and in accordance with foreign specifications. In the case of the first mentioned specification, the cylinders are suitable for a working pressure of 120 atmospheres, the stress in the walls and working pressure not exceeding 10 tons per square inch. The steel is produced by the acid or the open hearth process, and its chemical composition is within the following limits:—Carbon, 0.43 per cent. to 0.48 per cent.; sulphur, not more than 0.045 per cent.; phosphorus, not more than 0.045 per cent.; manganese, 0.5 per cent. to 0.9 per cent.; silicon, not more than 0.3 per cent. After manufacture the cylinders are

annealed by raising to a temperature of 820° C. to 850° C., and cooling in air, out of a draught.

To comply with the British Parliamentary report the conditions are much the same, the composition of the steel being carbon not more than 0.25 per cent. and total iron not less than 99 per cent. Cylinders are made for oxygen, hydrogen, nitrogen, coal gas, methane, carbon dioxide, nitrous oxide, ammonia, chlorine, phosgene, acetylene, etc.

Bevel-Edged Kegs and Drums

A NOVEL type of kegs and drums, embodying a special type of end, are manufactured by E. A. Brough and Co., of 4, Upper Parliament Street, Liverpool. By bevelling the ends and bringing the edges over and outside the drum, support is given to the body and provision is made for a certain amount of expansion in the drum end, thus safeguarding it against denting. The drums are welded by a combination of electric and oxy-acetylene methods. After the useful life of the container has been spent as a drum it can be converted into a keg, by removing the head and replacing it with a lid and clips, which are obtainable from the manufacturers. The makers state that in a test a drum was filled with water, and dropped from a height of 51 ft.; although dented it did not leak. The same drum subsequently withstood two similar tests.

Oil Storage Cabinets

OIL cabinets of various sizes and designs are made by the Valor Co., Ltd., of Aston Cross, Birmingham, and should form a valuable protection against fire and uncleanness wherever oil is stored in moderate quantities. The receptacles are tanks provided with double lids, to keep oil free from contamination, and a pump to draw off the liquid as required. If any oil overflows, it is not wasted, as often happens when drawing



A VALOR OIL CABINET.

off from a barrel, but it flows back into the tank. Various types can be supplied, either as single cabinets, or with two or more combined in one case.

The company also specialises in the production of fire extinguishers of various types—e.g., hand chemical extinguishers; foam extinguishers; marine extinguishers; Board of Trade extinguishers; dry powder extinguishers; fire buckets; London Fire Brigade hand pumps; and motor and electrical extinguishers. The Valor extinguishers are fitted with various special devices and made of special materials to prevent corrosion and deterioration.

Paste for Labelling and Packing

For purposes of labelling and packing, good adhesives are necessary. A cold flour paste suitable for labelling and packing any (even very delicate) materials is manufactured by R. Ker-Ramsay, of 75, Victoria Street, Westminster, London, under the name "Miracle" paste. It is guaranteed to be a pure grain product, and is easily rendered ready for use by pouring the flour into cold water and stirring. Claim is made that it will not stain or discolour the most delicately tinted papers or fabric. One hundredweight makes 7 to 10 cwt. of paste.

A Two-and-a-Half Million Gallon Tank

BRAITHWAITE AND CO., Engineers, Ltd., Broadway Buildings, Westminster, S.W., have received an order from the Government of Sarawak for a pressed steel tank of 2½-million gallons capacity. Apart from the immense capacity of this tank, which constitutes a world's record for size of any one tank, an outstanding example of engineering achievement is provided by the contract. The site of the tank at Kuching, the capital of Sarawak, is 10,000 miles distant from this country; nevertheless, the first half of the tank will be erected and supplying 1½-million gallons of drinking water in October, less than five months after receipt of the order. Then, by December, the entire tank of 2½-million gallons will be completed and in full operation. It is interesting to note that Braithwaite's in obtaining this contract beat the previous record for tank capacity, which was also held by themselves, by 1½-million gallons. The former "world's best" was the Braithwaite pressed steel tank supplied to the Municipality of Nairobi.

Chemical Party's Tour to Canada

THE number who have now booked to join the tour of the British Chemical Engineers and the Society of Chemical Industry to Canada and the United States in August is reported to be about 140. The majority of these are expected to leave by the White Star Liner *Megantic* from Southampton on Saturday, August 11, but a considerable proportion, mainly resident in the north of England, will leave on the same date by the White Star liner *Regina* from Liverpool. The original idea of a third tourist party is still being adhered to, though owing to the size of the party a small proportion may travel cabin. The problem of accommodation on the other side appears to have been satisfactorily settled, and the American hosts (the American Institution of Chemical Engineers and the American Section of the Society of Chemical Industry) have no doubt of their ability to entertain a party of 150. The booking and transport arrangements for the whole tour are in the capable hands of the Raymond and Whitcomb Co., London, and are now practically completed.

Among those who have definitely arranged to join the tour are Sir Alexander Gibb, Mr. F. H. and Mrs. Carr, Professor Jocelyn and Mrs. Thorpe, Dr. William and Mrs. Cullen, Professor Hinchley, Mr. Harold and Mrs. Talbot, Captain C. J. and Mrs. Goodwin, Mr. J. Arthur Reavell and Miss Reavell, Dr. L. A. and Mrs. Jordan, Dr. J. A. and Mrs. Cranston, Mr. F. A. and Mrs. Greene, Mr. F. E. Hamer (editor of THE CHEMICAL AGE), Dr. R. T. Colgate, Dr. R. S. and Mrs. Morrell, Mr. P. Parrish, Mr. C. P. Finn, Mr. G. A. Hebben, Mr. J. W. Napier, Mr. B. Nicholson, Dr. R. C. Farmer, and Mr. B. G. McLellan.

Progress of Minerals Separation, Ltd.

THE annual general meeting of Minerals Separation, Ltd., was held in London on Thursday, June 21. The chairman of the company, Mr. F. L. Gibbs, stated that considerable progress had been made on the metallurgical side of their business. In France a plant was now in operation treating arsenical ore, and several new contracts had been obtained. In Russia a plant had been erected at the Alagir Spelter Works for the treatment of lead-zinc ores. The Lena Goldfields, Ltd., had decided to instal the company's processes at their Degtiarka Mine for the treatment of copper ore. The Toyo Tin Co., Ltd., in Japan, were installing a plant for the treatment of tin ores, and a similar plant for the treatment of tin ores was also to be installed by the Polhigey Tin Co., Ltd., in Cornwall. The Eagle Lead Co., Ltd., were installing their processes for the treatment of lead-zinc ores in Wales. They had entered into an agreement with the Vanadium Corporation of America for the treatment of vanadium ores in Peru. He wished to impress upon the shareholders that the objects of the company to-day were exactly the same as they were when it was formed. These objects were to invent and develop metallurgical processes and to acquire raw material for treatment by such methods. It was with this object in view the company became interested to such a large extent in Rhodesia, which was a country of undoubted mineral wealth, containing great quantities of material suitable for their processes.

Annual Report of the Colour Users' Association

Review of the Year's Work

In the past few years the report of the Colour Users' Association has assumed great importance, in view of the expert comment and criticism which it affords of the dyestuffs situation. This year's report, which appears below, deals with a number of very interesting matters.

In the annual report of the Colour Users' Association for the year ended April 30 last, the council pays a tribute to the value of the services of Mr. Sutcliffe Smith as chairman for the seventh year in succession, and records with regret the death of Mr. Henry Allen and Mr. Alfred Barran. Mr. E. Carr Deakin, representing the Bleachers' Association, Ltd., was elected on the Council to fill the vacancy caused by the resignation of Mr. Allen, and Mr. James Nochar (Wallpaper Manufacturers, Ltd.) was appointed in place of Mr. Barran.

The Council continues to keep a watchful eye on the progress of the movement towards large combinations in the dyemaking industry, and has repeatedly placed the views of the Association before the leaders of I.C.I.

Dyestuff Licences

The Council records its grateful appreciation of the devoted services of the Association's representatives on the Dyestuffs Advisory Licensing Committee—Messrs. H. Sutcliffe Smith, T. N. Grant, C. C. Railton, and T. Taylor. Applications for licences have been dealt with expeditiously. In this connection the Council draws attention to the services rendered by the hon. technical adviser (Mr. George E. Holden, M.Sc., F.I.C.), to colour consumers generally.

It was stated in the last report that the Association's representatives were preparing a case for the reduction of the price factor from two and a half to twice the pre-war price. As a result of negotiations conducted by the Association's representatives, the factor in operation was reduced in September, 1927, to twice pre-war, and the possibility of a further reduction is receiving the careful consideration of the Council.

Dealing with procedure for applications for licences on price grounds, it is pointed out that the applicant is required to furnish particulars of the foreign quotation. The Licensing Committee report this quotation to the British makers, who thus have an opportunity of coming down to their competitors' price if they wish to keep the competitor out. This sometimes results in the refusal of the foreign maker to quote where there is a British equivalent. In the absence of foreign quotations there is no ground for application for a licence on price grounds, and consequently no remedy against the British makers' charges. With a view, therefore, to securing a continuance of competitive quotations on equitable lines, the Association's representatives on the Dyestuffs Advisory Licensing Committee are pressing for a ruling that foreign quotations accompanying an application on price grounds shall only be disclosed to the chairman and neutral members of the committee.

The Dyestuffs Industry Development Committee has met on very few occasions during the year. The question of prices charged by British chemical manufacturers has received consideration in connection with the prices of dyestuffs, and the Association's representatives have again pressed for the compilation and publication of authoritative statistics of the dyestuffs industry in this country. The Council expresses its thanks to the Association's representatives on this committee—Messrs. H. Sutcliffe Smith, W. H. Dixon and T. Taylor—for their continued services.

Prices and Statistics

The subject of foreign dyeware prices was dealt with at some length in the last report, and the subject is still engaging the attention of the Publicity and Statistics Committee. The data obtained by the deputation which visited the Continent in the spring of 1926 were of great assistance to the Council and the Association's representatives on the Dyestuffs Advisory Licensing Committee in the preparation of the case for the reduction of the price factor.

The Publicity and Statistics Committee have taken steps for the regular compilation and issue of prices of chemicals obtaining in Germany, Italy, France, and U.S.A. for comparison with the prices ruling in this country. The first two issues have already been circulated and received by the members with appreciation. The Publicity and Statistics Committee, in addition to keeping in touch with the dyestuffs situation on the Continent and in America, has given a great deal of

time to the consideration of the question of securing statistics of the dyestuffs industry both at home and abroad, and has succeeded in obtaining valuable data which it is collating with a view to forming conclusions as to the position of the dyestuffs industry in the various countries. Repeated requests have been made to the Dyestuffs Industry Development Committee to undertake the compilation and publication of statistics of the production, imports and exports of dyestuffs on lines similar to the *Census of Dyes* published annually by the United States of America Department of Commerce. This census is a most comprehensive survey of the dyestuffs position, and it is felt that similar information would be most useful in regard to the British industry. The Association's representatives on the Development Committee are continuing to press the matter. The committee has also recommended to the Council that greater publicity should be given to the work of the Association, and in consequence bulletins giving a résumé of the matters dealt with by the Association are being issued periodically.

Key Industry Duty

In the last report reference was made to the exemption of oxalic acid from duty under the Safeguarding of Industries Act for a period of twelve months. This time expired in March, 1928, and the Vigilance Committee applied to the Board of Trade for a renewal of the exemption, which has been granted until December 31, 1928. The Vigilance Committee continues to keep a watch on the position of colour users under this Act, and members are requested to communicate with the secretary of the Association with regard to any difficulty or points of interest.

Among the matters considered by the Vigilance Committee and the Council has been the question as to whether Dissolving Salt B was subject to the Dyestuffs Act in addition to being liable for duty under the Safeguarding of Industries Act. The liability to 33½ per cent. duty under the Safeguarding of Industries Act was not disputed, but the Board of Trade ruled that it was also subject to the Dyestuffs Act and licences must be obtained for its importation. The Vigilance Committee maintained that as the product was apparently not used in dyemaking, but only as a colour solvent, it did not come under the Dyestuffs Act. As a result of the representations made by the Association the Board of Trade agreed that the product was only liable to duty under the Safeguarding of Industries Act, and was not subject to the Dyestuffs Act.

The question of fadeless fabrics has again been considered by the Technical Advisory Committee, but as the Society of Dyers and Colourists has appointed a committee to deal with the whole question of fastness, it was decided to leave the matter over until the result of their deliberations was known.

The C.U.A. Buying Group has again co-operated with other organisations in the purchase of indigo under a system of rebate. Last year's contract expired on June 30, 1927, and the arrangements made worked satisfactorily, thousands of pounds value having been saved by users participating in the grouping arrangement. Particulars of the arrangements for 1928-29 will be circulated in due course to all members, and the secretary of the Association will be pleased to supply full information on request.

The John Benn Hostel Ballot

THE tickets and full prize list of over 350 items are now available. The list of prizes is a magnificent one, headed by a standard "Sherbourne" touring saloon car, and containing many novel and valuable gifts, including a "Reville" evening cloak, a combined billiard-dining table, a "Compactom" oak wardrobe, first class trip to Madeira and back, wagon loads of coal, gramophones, afternoon tea flights over London, etc. Sir Ernest Benn appeals to all readers to help to make the effort a huge financial success by (a) buying a ticket, (b) selling tickets to their friends, (c) asking others to sell tickets. Complete prize lists, posters, and tickets (1s. each), may be obtained from the Ballot Organiser, c/o Sir Ernest Benn, Bart., Bouverie House, Fleet Street, London, E.C.4.

The Chlorine Derivatives of Ethane and Ethylene

Use as Non-Inflammable Solvents and for Other Purposes

A pamphlet entitled "The Chlorine Derivatives of Ethane and Ethylene," setting out the chemical and physical properties of these substances, as well as their numerous applications in industry, has been issued by Imperial Chemical Industries, Ltd.

Some extracts from this useful publication appear below.

SINCE 1903 the manufacture of chlorine derivatives of ethane and ethylene, from chlorine and acetylene, has been carried out on a large scale. These chlorine derivatives form a valuable series of non-inflammable solvents whose boiling points range from 55° to 159° C. The physical constants of the series are shown in the table below.

Other anhydrous solvents commonly used for dissolving or extracting oils, fats, waxes, resins, etc., and for dry cleaning, are inflammable and liable to cause fire and explosion. Elaborate precautions are necessary to minimise these risks, but they can never be eliminated. Vexatious restrictions are imposed upon the storage and transport of inflammable materials, and the premium for fire insurance of works using them is very high. These disadvantages are avoided by the use of the chlorine derivatives of ethane and ethylene, which moreover possess in a marked degree the essential qualities of the ideal solvent.

Stability

Commercial dichlorethylene is a mixture of two dichlorethylenes which are stereoisomers. Trichlorethylene, perchlorethylene and tetrachlorethane are pure substances. They do not leave a residue, neither do they leave an "after smell." Pentachlorethane usually contains a trace of hexachlorethane but is otherwise pure. Dichlorethylene, trichlorethylene and perchlorethylene are quite stable, except when exposed to sunlight, and may be used in contact with all common metals even in the presence of moisture. Tetrachlorethane and pentachlorethane are stable in the absence of moisture under ordinary conditions. In the presence of moisture they are stable in contact with lead and tin, but other common metals reduce them to dichlorethylene and trichlorethylene respectively.

The boiling points of the members in this series range from 55° to 159° C., a range of amplitude which is not approached by any other group of solvents. Their rapidity of penetration is most marked, and the rate of solution of substances is very high, thus permitting very efficient extraction. Reference to the table of physical constants will reveal their low specific and latent heats. These qualities make them readily volatile. They are very easily condensed, but dichlorethylene requires a very well-cooled condenser on account of its low boiling point.

They are non-inflammable (with the exception of dichlorethylene), non-combustible and non-explosive. The liquids may, in fact, be used to extinguish fires. The hot vapours of dichlorethylene can be ignited and will burn with a cold flame, but this will extinguish itself and there is consequently no risk

of fire. There are no restrictions upon the storage or transport of these solvents, and fire insurance premiums are not increased by their use.

Hygienic Precautions

The hygiene of works using solvents is very important, as it has been shown that coal tar solvents, petroleum solvents, carbon bisulphide, acetone and chlorine solvents are all dangerous to health unless proper precautions are taken. The most important of these is to prevent as far as possible the escape of vapour into the air; the next is to provide efficient ventilation. All solvent vapours are heavier than air, and should be removed, whenever possible, at the point at which they are produced. Where this cannot be done removal should be effected by downward displacement, using suction fans situated either in the wall at floor level or in ducts under gratings in the floor. At the same time care should be taken to provide air inlets of sufficient area in the opposite side wall.

Chlorinated solvents, when used in properly ventilated buildings, are perfectly safe. If, however, their vapours are breathed continually men may be effected, and there is a danger that constant inhalation of tetrachlorethane may cause toxic jaundice, but it is found that men vary greatly in their susceptibility to solvent vapours. The chlorinated derivatives of ethane and ethylene are similar to chloroform in their tendency to induce intoxication and sleep when inhaled, although a large quantity is generally necessary to produce these effects.

Dichlorethylene

Dichlorethylene is $\text{CHCl} : \text{CHCl}$. The commercial product does not possess a constant boiling point, since it is a mixture of two dichlorethylenes which are stereoisomers. One of these boils at 48° and the other at 60° C. The specific gravity of the mixture is about 1.278 at 15° C. The hot vapours of dichlorethylene can be ignited, but they burn with a cold flame which will extinguish itself. In practice it is found that there is no danger from fire in its use. Like its most important relative, trichlorethylene, it is very stable and may be used in contact with all the common industrial metals and even with dilute alkalis.

Dichlorethylene is an excellent solvent, and is now used with marked success in place of low-boiling, highly inflammable solvents. In the perfume industry it is used for the extraction of delicate perfumes, whose odours would be completely changed by too high a temperature. For rubber, it is the best solvent known.

Table of Constants

	Name	Dichlor- ethylene	Trichlor- ethylene	Perchlor- ethylene	Sym Tetrachlor- ethane	Pentachlor- ethane	Hexachlor- ethane
Formula	$\text{C}_2\text{H}_2\text{Cl}_2$	C_2HCl_3	C_2Cl_4	$\text{C}_2\text{H}_2\text{Cl}_4$	C_2HCl_5	C_2Cl_6
Molecular weight	90.9	131.4	165.8	167.8	202.3	236.7
Boiling point	760 mm.	.. .. .	87°	—	—	—	—
	738.5 mm.	.. .. .	85°	119°	144°	159°	185° subl.
Vapour pressure at 20° C.	205 mm.	56 mm.	17 mm.	11 mm.	7 mm.	3 mm.
Specific heat at 20° C.	0.270	0.223	0.216	0.268	0.266	—
Latent heat (calc.)	71 Cal.	56.59 Cal.	51.59 Cal.	54.43 Cal.	43.64 Cal.	—
Coefficient of expansion	about 0.0013	0.001193	0.001078	0.000998	0.000909	—
Freezing point deg. C.	—	—73°	—19°	—36°	—22°	—
Specific gravity 15° C.	1.278	1.471	1.624	1.6011	1.685	2.09

In the laboratory it is rapidly replacing ether for organic preparations, because: It is much less dangerous to use; it is much more easily dried, since water is only very slightly soluble in it; and the yields obtained are as good as with other solvents, and in some cases better. In the operating theatre a dichlorethylene solution of iodine is used for the cleansing of skin, preparatory to surgical operations. Its use for power production in multiple vapour power plants has been suggested, and is now under investigation.

Trichlorethylene

Trichlorethylene is $\text{CHCl}_2 \cdot \text{CCl}_2$. It is a pleasant-smelling liquid of Sp. Gr. 1.47 and boiling point 87°C . It is the most important member of this group of non-inflammable solvents, and most nearly complies with all the demands made on the ideal solvent. The commercial product is a pure substance, whose boiling point range lies within 1°C . There is no high-boiling residue left behind in the material extracted, so that the last trace of solvent may easily be removed.

Trichlorethylene does not attack the common metals even in the presence of moisture, and there is no difficulty in constructing plant for its use at a reasonable cost. It is a very rapid worker, and may be used for the extraction of either moist or dry materials. In comparison with benzene, in the same apparatus, it yields a larger output in a given time. It is non-inflammable and has a low latent heat of evaporation. It is heavier than water, and therefore may be kept under water to prevent evaporation.

Trichlorethylene is used to-day in large quantities in the extraction industry. Its purity makes possible the extraction of delicate fats without damage. It is also largely used for degreasing. It is used for the solution of resins, tarry and bituminous products; india rubber and many organic substances; sulphur and phosphorus; in the preparation of rubber-cements, and in the varnish, paint and lacquer industry.

Its valuable cleansing properties have led to its extensive use for dry-cleaning, where its non-inflammability is greatly appreciated; also to its incorporation with soap in laundry and scouring preparations.

Perchlorethylene

Perchlorethylene is $\text{CCl}_2 \cdot \text{CCl}_2$. It is a liquid of Sp. Gr. 1.624 and boiling point 119°C . Like trichlorethylene, it does not attack metals even in the presence of moisture, and as a solvent it possesses similar properties. The pure substance is more expensive than trichlorethylene, but where a solvent is required which is less volatile than trichlorethylene, but has the same properties, a mixture of trichlorethylene with 50 per cent. or more perchlorethylene is suitable. Perchlorethylene is used for dry-cleaning and for the manufacture of solvent soaps.

Tetrachlorethane and Pentachlorethane

Tetrachlorethane is $\text{CHCl}_2 \cdot \text{CHCl}_2$. Like its derivatives, it is non-inflammable. It is the parent substance of the chlorinated derivatives of ethane and ethylene, and is the most powerful solvent of the whole series. It dissolves oils, fats, waxes, resins and tarry substances; also sulphur, phosphorus and chlorine. It dissolves 1 per cent. of sulphur at ordinary temperatures. The solubility increases as the temperature rises, until above the melting point of sulphur the two substances are miscible in all proportions. It is used as a solvent for varnishes, especially cellulose acetate, and in the preparation of paints; as a paint remover and a degreaser of metals; and to a large extent as a solvent for all kinds of organic products. Tetrachlorethane is extensively used as an insecticide, especially for white fly on tomato plants and for various weevils.

It distils without decomposition, and may be steam distilled quantitatively from all its mixtures. It should be noted that, though dry tetrachlorethane does not attack the common metals, only lead and tin are free from attack in the presence of moisture.

Pentachlorethane is $\text{CHCl}_2 \cdot \text{CCl}_3$. It is similar in its chemical and physical properties to tetrachlorethane, and is sometime used to replace it where a higher boiling point and lower volatility are desired. It has a specific gravity of 1 and a boiling point of 159°C .

Hexachlorethane

Hexachlorethane, $\text{CCl}_3 \cdot \text{CCl}_3$, the last member of this group, and is a solid which possesses the property of subliming at 185°C , without melting. It has a smell similar to camphor.

It is used as a substitute for camphor in the celluloid industry; to render substances non-inflammable and, in the explosive industry, for the preparation of safety explosives; as an insecticide and germicide, and in antifouling paints.

National Physical Laboratory

Annual Visitation

THE annual inspection of the National Physical Laboratory took place on Tuesday, a very large number of guests (including many scientists of distinction) being present.

Among the matters now under investigation at the N.P.L. are the mechanical properties of substances at 800°C . At the present day materials used in engineering and chemical practice are required to withstand much higher temperatures than formerly. In boiler and superheater design this is due to the use of steam at much higher pressures and temperatures. Until quite recently the strength of materials at high temperatures was estimated by breaking a test piece at the required temperature in a testing machine of the usual type, the test lasting a few minutes only.

It has been found that at high temperatures metals and alloys will gradually increase in length under a constant tensile load and finally fail after a period which often extends over some months. With newly designed methods of testing, an endeavour is being made to find the maximum loads at different temperatures which such materials will stand for many years when the loads are continuously applied. Such maximum load at any temperature is called "the limiting creep load" for that temperature. As an example there may be taken the case of a nickel-chromium alloy at 800°C , of which the breaking strength obtained by the ordinary testing machine was 18 tons per sq. inch. A load of two tons per sq. inch, continuously applied, broke a similar test piece in 37 days. Various steels and non-ferrous alloys are being investigated.

In the metallurgy department interesting work is in progress. The production of beryllium is still under investigation, as are also its properties and those of its alloys. Other work of interest is that dealing with the adsorption of hydrogen by the steel used in coal hydrogenation apparatus. Mild steel from such an apparatus used at the Fuel Research Station has been found to contain 180 c.c. of hydrogen per 100 grams. The steel at the same time becomes brittle.

Colorimetric Apparatus

In the optics building, the apparatus shown in connection with the measurement of colour included equipment arranged for determining the properties of the "normal" eye, based on measurements of the spectrum colours by a large number of observers. When this determination is completed, it will form a connecting link between the various practical methods of colorimetry and the physical properties of colouring materials.

The subject of colour measurement is of considerable commercial importance in connection with the dyeing of fabrics and the paint and varnish industry. The work carried out at the Laboratory during the past few years has rendered possible the introduction of scientific methods in place of the empirical and unrelated methods of measurement on which technical colour workers have had to rely in the past.

3,000,000 Dollar Loan for Ruhr Waterways

CABLED advices from New York state that the Ruhr Association (Ruhrverband), an association comprising numerous German municipalities and industries, has secured a loan of \$3,000,000 in the American market for the improvement of its sixty water purification plants and the recently constructed hydraulic station on the Ruhr river. The loan was offered on Wednesday by the Chase Securities Corporation of New York and E. H. Rollins and Sons in the form of five-year $6\frac{1}{2}$ per cent. external gold notes of the Ruhrverband.

The Ruhrverband is an association dating from 1913, which was formed for the purpose of purifying the Ruhr waterways, an important work in territory so highly industrialised. Among its members it includes the cities of Essen, Duisberg, Bochum, Mulheim and Oberhausen, together with the German Railway Co., United Steel Works of Duesseldorf, the Harpener Mines, Lorraine Mines, Goodhope Steel Works and the Ruhr Water Power Association.

Position and Prospects of the Chemical Merchant

Mr. Victor Blagden on Import Duties and Combines

At the annual meeting on Thursday in London of the British Chemical and Dyestuffs Traders' Association, the President (Mr. Victor Blagden), in reviewing the work of the year, referred to the operation of the Safeguarding of Industries Act from the point of view of the chemical merchant, and discussed the effect on prices of the formation of large manufacturing combines.

MR. BLAGDEN, in reviewing the Association's activities during the past year, dealt first with the Merchandise Marks Act. The difficulties, he said, which the trade might have had to contend with under this new legislation had been largely cleared away. The Board of Trade saw fit to issue an exemption order in respect of chemicals used for medicinal purposes. That appeared to have been done because the Act threatened to be rather inconvenient to the not inconsiderable number of so-called manufacturers of chemicals who were largely nothing more than decanters. Did they suppose that if the application for this exemption to make legal a practice which the Act expressly made illegal had come from the merchant interests, it would have been considered, much less granted? Their Council at length obtained a ruling from official quarters that shipping marks, which had previously been deemed liable to the marking provision of the Act, should be excluded. It was the only point which affected the wholesale merchant in imported chemicals.

Key Industry Duties

The Association's work in looking after the merchant's interests in connection with the Key Industry Duties had been continuous throughout the year. A ruling by H.M. Customs that "containers on loan and returnable" were to be liable to duty, to the extent of the cost of returning them, was contested. Some few years ago the same point arose. At that time Customs ruled that they were to be dutiable to the full extent of their value. The Association secured the withdrawal of that decision. This latest idea was a more subtle attempt to levy duty in a manner that was never intended. They again contested the point, and in the end, after months of negotiation, Customs agreed to withdraw this new demand. During the past seven years, he wondered how many times Customs had brought in some new regulation—a further obstacle to the business of the merchant—and then had to withdraw or greatly modify it. They could claim, with some satisfaction, that it was entirely due to the Association that, in general, invoice values were now the recognised basis of values for the purposes of assessing the amount of duty payable, whereas early in the life of this legislation, there was a very determined effort that the prices current of British makers should be the basis. There was, as they knew, a considerable difference.

During the year the Association had seen to it that the new clause in the Act providing for exemption orders allowing free import of products not manufactured here, had been made good use of. The list of important products which had, during the year, become free imports was fairly substantial, and they would resist any attempt in the future to curtail it unless the position as regards non-production in this country was changed. Many of the exemption orders now in operation would not, in his opinion, have been issued had it not been for the pressure brought to bear by the Association. It took them over twelve months to get oxalic acid exempted. It took them even longer, although it was not for want of trying, to get hydroquinone made a free import, and in the case of B.P. lactic acid over two years elapsed before the application was granted. There were still some products which should have been exempted long ago which were not being made here, but which they were told someone was proposing to make. They would continue to press for exemptions in these cases.

Extending the "Fine" Chemical List

He mentioned last year that an attempt had been made to add a large number of industrial chemicals to the dutiable list. This movement was detected by the Association, and a vigorous protest had the effect of checking it. There had been a development which, if allowed to pass unchallenged, might have the effect of changing the Act, from its proper limits of protecting the fine chemical branch of the industry, to an import tariff on practically all chemicals, irrespective

of their character. They were informed that complaint had been lodged with the Board of Trade against the exclusion of a considerable number of what were in their opinion typical heavy chemicals. Their inclusion in the list of dutiable articles was claimed on the ground that they were "fine chemicals." They would all have followed the proceedings in the first case taken before the Tribunal, namely, that of calcium biphosphate. It would not be politic for him to make any comment on the Tribunal's decision. He would limit himself to saying that he hoped the Board of Trade did not accept the decision as a precedent and intend to apply it to the other products which were the subject of complaint.

Their Council was alive to the danger of this first move to get a wide range of admittedly "heavy" or industrial chemicals included in the list as "fine" chemicals, and nothing would be left undone in order to resist it. They had never opposed the true idea underlying this legislation, namely, the establishment on a sound basis in this country of a key industry for national defence; but they would oppose this and any other movement to abuse an Act of Parliament by using it to obtain general protection for that part of the chemical industry which no one could deny was well established, and was, in fact, one of the strongest in every respect in the country.

During the first five years of the Act a fair definition of what was a fine chemical was reached. A number of cases were heard by the Referee, and his rulings were accepted by all concerned. They never complained, although his views sometimes did not coincide with theirs. They accepted his reasoned decisions as honest, impartial, and careful efforts to define the term "fine chemicals." Now, after some years of freedom from these expensive contests, they were faced with this very serious and determined effort to overthrow what was the generally accepted and proper definition of a fine chemical, and to widen it sufficiently to cover almost any industrial chemical. This was the back door method by which it seemed the manufacturers of industrial chemicals were endeavouring to obtain protection on everything.

Combines' and Consumers' Interests

Before closing, he wished to say something about the position of the merchant trading in chemicals as he saw it to-day. Last year he spoke at some length on the movement towards combines, rings, and syndicates, both in this country and abroad, setting up national and international monopolies. At that time the professed reason set forth for these developments was to avoid overlapping and especially to reduce costs of production. The promoters of these giant commercial undertakings had stated that consumers would benefit by obtaining their materials at lower prices, and that the centralisation and concentration of groups of individual and hitherto competitive manufacturing concerns, working under one uniform direction, was being undertaken for the consumer's benefit. His experience was that the amalgamation or co-operation of a number of industrial companies was not economic; rather did they become unwieldy and wasteful. They might, by their very power, succeed from the financial point of view, but it was always done at the consumers' expense.

In his view, there was one, and only one, real object behind the setting up of monopolies, and that was the elimination of competition to enable selling prices to be raised.

Despite the considerably changed conditions of business in chemicals which had been experienced during the past few years, he was still of opinion that there was room for the *bona fide* merchant. So long as the merchant carried on his business in an efficient and economical manner, offering to the consumer a competitive market and the benefit of his knowledge of the world's markets, and giving the guarantee of reliable quality and often financial assistance, so long would the merchant be a vital and necessary part of the industrial machine.

Synthetic and Natural Fertilisers

Comments on the Action of the Chilean Government

THE general meeting of the Angela Nitrate Co., Ltd., was held in London on Tuesday. The chairman, Mr. H. W. Morrison, said that last year, when he addressed them, he stressed the necessity of a reduction in the Chilean export duty to enable their product to maintain its position in competition with synthetic nitrogen products. The past year had seen the transition stage in that free selling had been instituted, with a resultant drop in price of approximately £2 per ton, against a reduction of only 5s. to 10s. per ton by the synthetic producers, and a large increase in the consumption of their product from 1,750,000 tons to approximately 2,500,000-2,550,000 tons had taken place; but the prices at which that had been achieved had shown a meagre profit to the best-placed producers and no profit to many others if adequate amortization was taken into account. Any further cut in price by their synthetic competitors would, therefore, without help from the Chilean Government, have spelt disaster to the nitrate industry.

They were informed that the Chilean Government had given much time to studying the situation, which, after all, was all-important to Chile, and, although no direct reduction in the export duty had resulted, some important concessions had been made. The first was the promise of a subvention of £250,000 to be distributed among producers *pro rata* to their January-March, 1928, production, which was the equivalent of 8d. per metric quintal on such production, but a condition laid down was that no producer would be eligible to this subvention if, after the date on which it was announced, he sold May-June shipment and onwards at less than 16s. 4d. per metric quintal. A fund of £1,500,000 had been allocated by the Chilean Government to the assistance of the nitrate industry, which had created hopes that the above subvention might be renewed each three months; but on that point there had, so far, been no official pronouncement.

Agreement on World Prices?

The next concession might have far-reaching consequences, as it was an undertaking by Chile to refund to the producers any reduction—whether it be 5s. or £2 per ton—which the I.G. Farbenindustrie, by far the most important of the synthetic producers, might make in their prices during the coming year. That refund has to be passed on by the producers to their buyers in the case of contracts already made at the time when the Farbenindustrie's new prices were announced, but on any sales made after that date the producers would retain the bonus for their own account, which would enable them to reduce their prices to compete with the lower synthetic prices. That would appear to be a clear statement of policy by the Chilean Government that they were willing to recognise the respective prices at which Chilean nitrate and synthetic nitrogen had been sold during the past year, but they would not allow the Chilean article to be placed in a worse position in future. That announcement, to his mind, was of much greater importance than had been generally realised, and might be the forerunner of a general agreement on world nitrogen prices. Since the above concessions had been announced the Chilean Government had addressed a letter to the association stressing the point that, in their opinion, the present method of free selling was not the best for the industry, and requesting the association to submit to the Government within one month a scheme for the general centralisation of sales in consuming markets. The matter was now receiving the careful attention of the association, who had appointed a sub-committee to draw up a scheme.

Potash in Texas

ANOTHER find of potash discovered through governmental agencies was made public by the U.S. Interior Department recently. The U.S. Geological Survey has recently completed its analyses of cores received from four tests well drilled by the Bureau of Mines under the Potash Act, which provides for joint explorations by the Department of the Interior and the Department of Commerce. In the interval between the depths of 1,935 feet 7 inches and 1,945 feet in well No. 4, drilled in south-western Ector County, Tex., are two potash beds that have a combined thickness of 6 feet 7 inches and together contain 12.86 per cent. of potash (K_2O) in the sample as received, equivalent to 18.98 per cent. in the soluble salts.

Tax on Oils

F.B.I. Deputation to Treasury

A DEPUTATION from the Federation of British Industries, representing the trades principally affected by the proposed tax on oil, was received at the Treasury last week. Mr. J. Davidson Pratt and Mr. Merriam represented the Association of British Chemical Manufacturers.

Different sections of the deputation presented their views to the Chancellor of the Exchequer, who was accompanied by the Financial Secretary of the Treasury, the Chairman of the Board of Customs and Excise, and other Treasury officials.

Mr. Pratt dealt with chemical products where dutiable oils were used as ingredients, though in the final article produced such oils had entirely lost their character. He referred particularly to the small key industry established for the manufacture of synthetic camphor, and to the production of terpineol. The effect of the duty on the synthetic camphor industry would be to make competition with foreign supplies practically impossible. The cost of remitting the duty would mean a loss of only £900 per annum to the Exchequer at the present moment, and if the full manufacturing facilities were used it would not amount to more than £3,600.

The Chancellor, in reply to Mr. Pratt, said that where oil was used as an ingredient which did not remain contained in the finished product (which happened in the case of synthetic camphor and terpineol and certain other chemical products) it was, of course, the fact that they were unable to charge the oil duty on the foreign import or to give a drawback to the home producer, but he could only say in regard to this group that he could not vitiate the whole machinery of the tax for the purpose of meeting this particular difficulty.

Sensible Heat Distillation: General Meeting

At the general meeting of Sensible Heat Distillation, Ltd., held on Monday at St. Ermin's Hotel, S.W.1, the chairman (Mr. Frank Middleton) mentioned that they were now effecting agreements for the exploitation of their "L. and N" process of low-temperature distillation of coal in various countries abroad, two of which should shortly be completed. He then read an opinion and accompanying letter to himself from their patent adviser, stating that the patents of the process covered broad claims for the production of fuel products from coal previously never obtained by research workers. These included, *inter alia*, lubricating oil, and a new residual fuel most suitable for the production of cheap water gas and inexpensive to produce. Eminent foreign coal scientists were prepared to assist their technical staff, while continental coalowners were abandoning their recent price-cutting campaign in raw coal throughout the north-east of Europe and were turning towards low-temperature distillation. This new industry did not compete with the present gas industry as it used low-grade slack, which was otherwise unsaleable. Residual fuel, properly produced, was a rival to oil fuel in fluidity, use, and price. Their German office was designing units to treat 3,000 tons of coal a day. By coal distillation British and other collieries could be saved.

Production of Mercury in the U.S. in 1927

ACCORDING to figures compiled by the United States Bureau of Mines, Department of Commerce, the production of mercury in the United States in 1927 amounted to 11,276 flasks of 75 pounds each, as compared with 7,642 flasks in 1926. The average price of mercury at New York is quoted as \$118.16 per flask of 76 pounds, equivalent to \$116.60 per flask of 75 pounds. The average quotation for 75-pound flasks for 1926 was \$91.90. In 1927, 24,650 flasks of mercury, valued at \$2,189,495, were imported, compared with 28,614 flasks, valued at \$1,971,458, in 1926. Of the 24,650 flasks imported in 1927, 13,663 flasks were derived from Spain, 9,089 flasks from Italy, 1,843 flasks from Mexico, 51 flasks from Netherlands and 4 flasks from Chile. In 1926, 14,117 flasks came from Spain, 11,768 flasks from Italy and 2,729 flasks from other countries. On December 31, 1927, there were 5,736 flasks of mercury in bonded warehouses compared with 2,277 flasks at the end of 1926.

Are Chemists' Prospects Improving?

To the Editor of THE CHEMICAL AGE.

SIR,—I was rather amazed at some of the statements which appeared in the article by "A Research Chemist" in your issue of June 23. Surely no member of the chemical profession believes that the prospects of the young chemist, fresh from college, have improved one jot during the last two years. No matter what research training he may have had, the progressive firm of to-day still regards him as without experience and pays him accordingly, usually about £175-£200 per annum.

Such a salary is scarcely encouraging to a man after perhaps five years of training, which have cost anything up to £1,500, and jobs even at this salary are by no means plentiful. In fact, it is rather hard to believe that anywhere to-day the demand for graduates exceeds the supply, as the writer of the article optimistically asserts. He also implies that the majority of research chemists would rather do research and only take an administrative post under protest. Most of the research chemists of to-day, I think, have one main object, and that is to earn a living. Whether they do research or administration is of secondary importance to them. If, however, he will publish the places where the demand for graduates exceeds the supply I, for one, would be extremely grateful.—Yours, etc.,

PH.D., UNEMPLOYED.

Elections to Institution of Chemical Engineers

THE following have recently been elected to the Institution of Chemical Engineers: MEMBERS: J. W. Brown, Barbados Gas Co., Ltd.; W. M. Cumming, D.Sc., F.I.C., Royal Technical College, Glasgow; T. W. Evans, Pemberton Colliery Co., Wigan; W. E. Gibbs, D.Sc., A.I.C., Dept. of Chemical Engineering, University College, London; G. A. Hebden, South Yorkshire Chemical Works, Ltd.; P. J. Hinks, A.R.C.S., F.I.C., Royal Filling Factories, Woolwich Arsenal; A. A. King, Albright and Wilson, Ltd.; L. J. Lepine, M.I.Mech.E., M.I.E.E., consulting engineer, London; E. I. Lewis, M.A., B.Sc., Hy. Wiggin and Co., Ltd., Birmingham; W. D. MacKenzie, Savonneries Lever Frères and Raffineries du Congo Belge, Brussels; B. G. McLellan, A.R.T.C., F.I.C., Rowntree and Co., Ltd., York; L. O. Newton, Sofnol, Ltd., London; A. Shaw, Washington Chemical Co., Ltd., Co. Durham; G. E. Shaw, B.Sc., F.I.C., Bengal Government.—ASSOCIATE MEMBERS: A. J. Ambrose, A.S.T.C., Manly Gas Company, Australia; R. S. Andrews, B.Sc., Metropolitan Gas Co., Melbourne, Australia; H. D. H. Drane, M.Sc., Ph.D., A.M.I.E.E., Thermal Syndicate, Ltd., Wallsend-on-Tyne; S. E. Fox, B.A., Lang London, Ltd., London; I. P. Mathur, B.Sc., industrial research student, Vienna; T. H. Parry, B.Eng., Brunner, Mond and Co., Ltd., Northwich; M. Salomon, B.A., M.Sc., Sulphuric Acid Dept., African Explosives and Industries, Northrand, S. Africa; C. D. Walton, Celanese Corporation, Amcelle, U.S.A.; T. Westthorp, Langley Park Coke and By-Products Works, general secretary, Coke Oven Managers' Association; J. P. V. Woollam, Chemical Plant Dept., Simon Carves, Ltd., Manchester.—GRADUATES: H. S. Pink, B.Sc., M.S., A.I.C., British Dyestuffs Corporation, Huddersfield; W. A. Rae, B.Sc., A.R.C.Sc., Imperial College of Science and Technology, London; F. F. Rixon, B.Sc., Imperial College of Science and Technology, London; H. Smith, B.Sc., A.R.C.Sc., Imperial College of Science and Technology, London.

Evaporation and Heat Transmission

AN unusually interesting publication, having the title *Evaporation and Heat Transmission*, has been issued by the Kestner Evaporator and Engineering Co., Ltd. It contains two papers. The first is entitled "Evaporation in the Chemical Industry with Particular Reference to the Kestner Evaporator," by J. A. Reavell, M.I.M.E., M.I.Chem.E., and was read before the Society of Chemical Industry; the second, "Heat Transmission in Coolers, Heaters and Condensers," by Basil Heastie, Assoc.M.Inst.C.E., M.I.Chem.E., was read before the Chemical Engineering Group. The pamphlet (comprising 64 pages) is excellently illustrated with photographs and diagrams.

Breach of Contract Claim

Acid Calcium Phosphate and the Foods and Drugs Act

AN important action, which was the sequel to a prosecution for the selling of baking powder the arsenical content of which was above the standard, came before Judge Moore, in the Southwark County Court, on Tuesday, when John Simons, of Leroy Street, Tower Bridge Road, London, a baking powder manufacturer, sued Smith, Hughes and Co., of College Hill, London, chemical merchants, to recover £71 13s. 2d. The plaintiff's claim was for damages for breach of contract for the sale of 20 one-cwt. kegs of acid calcium phosphate, which the defendants were alleged to have expressly warranted to be of the nature, substance, and quality described, and to comply with the Foods and Drugs Act. The defendants denied that they gave any warranty as to the acid calcium phosphate, and contended that if such warranty was given, the acid calcium phosphate complied with it. The acid calcium phosphate was not manufactured by them, and as they sold it under the manufacturers' guarantee they were indemnified. They further denied the accuracy of the analysis. Mr. Fox-Andrews appeared for the plaintiff, and Mr. Parry for the defence.

From counsel's opening statement, it appeared that the defendants supplied the plaintiff with one ton of acid calcium phosphate, and the plaintiff used this with other ingredients in making baking powder. This he sent out to his customers, and one, Mr. Carter, of Hedingham, Essex, a grocer, was prosecuted for having an arsenical content above the standard, and was fined £5 and £5 costs, which the plaintiff paid. In view of this, he circularised his customers to get back the baking powder, and had been put to great expense. This was borne out by the plaintiff, who said that his baking powder was made up of acid calcium phosphate, bicarbonate of soda, and rice flour in equal proportions.

Evidence by Analysts

Dr. Bernard Dyer, public analyst to the County of Essex, said that a sample of the baking powder which he analysed was arsenicated to the extent of 1-16th of a grain. He tested the powder with the Marsh and Gutzeit test, using different quantities. In cross-examination, he said that bicarbonate of soda and rice flour were very pure, and arsenic would not be found in them, so the arsenic must have been in the acid calcium phosphate. The recommendations of the Royal Commission were not statutory, but they were accepted by analysts, the courts, and the trade. Acid calcium phosphate was an ingredient used every day in food. He agreed that the British Pharmacopœia allowed this substance to contain five parts of a milligram of arsenic, and described it as a fine chemical. Questioned as to whether he would describe it as a food or a chemical, he said that legally speaking it was a food and was under the Sale of Foods and Drugs Act.

Dr. H. E. Cox, public analyst to the Borough of Hampstead, said that in the samples of baking powder and acid calcium phosphate submitted to him, he found 1-14th of a grain of arsenic in the baking powder, and nine parts of a milligram in the phosphate. He agreed with Dr. Dyer that the British Pharmacopœia Codex fixed the standards of purity, but said they applied to medicines and drugs, and not foodstuffs.

The Defence

For the defence, Mr. E. J. Parry, analytical chemist, said that in the samples submitted to him he found the arsenical content to be six to seven parts of a milligram. He attributed the difference between the results of the analyses to two things; one was that the arsenic must have been present in the bicarbonate of soda, which was very improbable, and the other that it was not the same acid calcium phosphate.

This evidence was corroborated by Mr. Taylor, the public analyst for Acton.

Bertram Levine, sales manager to the defendants, admitted that it was not desirable to have arsenic in foodstuffs, but he would not refer to acid calcium phosphate as a foodstuff. They asked the Local Government Board to put a standard of purity on it, but they refused.

Judge Moore reserved judgment.

Scientific Control of Lyons' Products Functions of the Laboratory

DURING his speech at the general meeting of J. Lyons and Co., Ltd., on Tuesday, Mr. A. Salmon, who presided, said that some of the shareholders might have noticed the very handsome building which was being erected in Hammersmith Road, almost opposite to Cadby Hall, and it might have struck them as very large to have only the word "laboratories" attached to it, but they looked upon that as essential to carrying on a business such as theirs. A good deal of public attention was now, if a little late, being paid to the purity and quality of foodstuffs—in their opinion quite properly.

But, while the main function of the laboratory was to ensure the purity of the food supplied by them, it had other functions. It was used to ensure that all the raw materials which they purchased were up to standard and pure in every sense of the word, and also to assist in carrying out their manufacturing processes as efficiently and economically as possible. Next, it had to investigate all new processes and all new products which were brought to their notice, and to conduct research work for the general betterment of their products.

There was one point, however, which he would like to stress, namely, that their employment of scientific staff did not imply any seeking after artificial foods. Their object was to employ to their full advantage what he might call natural foods, and not to develop the use of substitutes or artificials. The time might come when they would have to produce foods, more or less artificial, in tabloid form, but they thought that was so far in the future that it formed no part of the policy of their use of the laboratory. The laboratory was like the rest of the concern—it spread its energies while keeping them under strict control over a wide area. It was not merely interested in chemistry, but in bacteriology, engineering, and in whatever kindred scientific subject might tend to the improvement of the company's goods, and therefore its business.

Professor Kendall's Farewell Letter

PROFESSOR JAMES KENDALL, of New York University, is leaving America in order to take up his new appointment as professor of chemistry in the University of Edinburgh. The current number of the news edition of *Industrial and Engineering Chemistry* contains a letter in which he takes leave of the many friends he has made in the United States, and thanks them for their kindness and courtesy to him during his fifteen years in America. In the course of the letter he says that he wishes to be considered "not as one who has cut away completely his ties with the American Chemical Society, but rather as its accredited ambassador to Scotland, where it will be my pleasant duty to advance, in every possible way, the interests and comfort of all American chemists who may venture within my sphere of influence."

"There has always been an exceptionally intimate connection between chemistry in Edinburgh and chemistry in America. Edgar F. Smith, whose recent loss is mourned by chemists in every land, repeatedly draws attention to this fact in one of his last books, *Old Chemistries*. Benjamin Rush, signer of the Declaration of Independence and holder of the first chair of chemistry in the University of Pennsylvania (the first, indeed, anywhere in America), received his instruction in chemistry directly from Joseph Black. John Gorham, professor at Harvard, and Benjamin Silliman, the elder, professor at Yale, also studied chemistry at Edinburgh. In later years the tide of travel has tended in the reverse direction, and few men have done more to promote the teaching of chemistry in America than an Edinburgh alumnus—Alexander Smith."

"It is my humble but earnest hope that this kinship will acquire, by my return to Scotland, a new link, and that many post-graduate students from the United States, when they plan to expand their outlook in science by study abroad, will remember that the chair of Joseph Black is now occupied by one who understands their requirements from personal experience, and is always at their service for advice and assistance. As an ambassador also, I trust that I shall find frequent occasion to revisit America and to report at future meetings of the American Chemical Society, even although it may not be possible for me to rival Sir Harry Lauder (or Sir James Irvine) by indulging in the luxury of an annual 'farewell tour.'"

Chemical Matters in Parliament

Beet Sugar Factory Wages

In answer to questions by Mr. T. Kennedy and Mr. G. Hardie (House of Commons, June 21) regarding wages at the Prestonhall beet sugar factory, Major Elliott stated he hoped no cause for complaint might arise during the next manufacturing season, but if it did, it would be open for persons aggrieved to make representations to the Board of Agriculture for submission to the Industrial Court.

Mr. Hardie asked whether the hon. and gallant member considered that 84 hours per week was something that was quite in order, and did he think that the wages of a chemist amounting to £3 or £4 a week was payment for work done? Major Elliott stated that any person who was aggrieved in the matter had a right of appeal.

Synthetic Cream Bill

Mr. Baldwin stated (House of Commons, June 26) that owing to pressure of Government business he regretted he could see no prospect of special facilities being found this session for the Reconstituted and Synthetic Cream Bill.

Geo. Adlam and Sons: Issue of Shares

AN offer for sale was made this week by the Lothbury Investment Corporation of 100,000 eight per cent. cumulative preference shares of £1 each and 100,000 one shilling ordinary shares of George Adlam and Sons, Ltd., of Bristol, the former at par and the latter at 2s. per share. Founded nearly 100 years ago, the firm was formed into a limited company in 1908. The principal business comprises the designing and manufacture of various types of chemical plant and every kind of brewery plant, bottling and refrigerating machinery, a speciality being the design and layout of brewery buildings and their complete equipment. In addition to offices and warehouse, the company has in Bristol extensive iron and brass foundries, with machine shops, etc., works for manufacturing steel tanks, structural steel work, vats, etc., as well as works for the manufacture of large copper vessels, vacuum pans, and all copper work required in connection with the brewing, chemical and artificial silk trades. Net assets are certified at £102,374, nothing being included for goodwill. It is shown that following a few years of fluctuations, profits steadily rose from £13,685 in the twelve months to May 31, 1924, to £27,086 in 1926-27. The accounts for the year to May 31 last are not yet completed, but in the chairman's opinion the profits will not be less than those for 1926-27. Interim dividends and bonuses, amounting to £22,000, have been paid out of the profits for the past year. On the basis of the 1926-27 profits the preference dividend is covered more than 2½ times, the balance being equal to over 50 per cent. on the ordinary capital.

Appointments Vacant

ASSISTANT FOREMAN for the Acid Section of the Indian Government Cordite Factory, Aruvankadu. Candidates should have had considerable experience in an acid works, and must have had experience of sulphuric acid manufacture (chamber process). Full details of this post are given in our advertisement columns, p. xxxiii.

ASSISTANT LECTURER IN AGRICULTURAL CHEMISTRY in the University of Leeds.—The Registrar, The University, Leeds. July 7.

LECTURER IN CHEMICAL ENGINEERING in University College, London. Further details appear in our advertisement columns, p. xxxiii.

CHEMIST with experience in distillation of essential oils, etc. See p. xxxiv. of advertisements.

ASSISTANT CHEMIST for food factory. See p. xxxiii of advertisements.

Honour for Professor G. S. Whitby

THE FRENCH GOVERNMENT has conferred on Professor G. S. Whitby, the Department of Chemistry, McGill University, Montreal, the distinction of "Officier d'Académie," this being the first grade of the decoration "Officier de l'Instruction Publique." Professor Whitby was also elected as the first President of the Canadian Chemical Association formed at the Eleventh Dominion Chemical Convention held at London, Canada, June 6-8.

From Week to Week

THE PRODUCTION of cinchona bark in the Dutch Indies in 1927 was 12,692 tons.

THE NAME of the Industrial Chemical Co., of New York, has been changed to Industrial Chemical Sales Co., Inc., 200, Fifth Avenue, New York, N.Y.

THE NATIONAL FEDERATION of CLAY INDUSTRIES announces that its address is now as follows: Drayton House, Endsleigh Gardens, London, W.C.1.

RUTHS STEAM STORAGE, LTD., having been recently formed as a public company, the private company under the title of Ruths Steam Accumulators, Ltd., has gone into voluntary liquidation.

PHOSPHATE ROCK produced on the island of Nauru for the year ending June 30, 1927, amounted to 594,825 tons. Australia took 78 per cent. and New Zealand 22 per cent.

A PARTY of OVER FORTY Ponteland members of the National Farmers Union visited the works of Imperial Chemical Industries, Ltd., at Billingham, on Thursday, June 21.

MESSRS. W. AND G. FOYLE, LTD., booksellers, recently organised an essay competition on the subject of "Literature in Commercial Life," in which Sir Ernest Benn acted as judge.

DR. H. TROPSCH, of the Kaiser Wilhelm Institute for Coal Research at Mulheim-Ruhr, who has collaborated with Professor Fischer, has been appointed director of the new Coal Research Institute at Prague.

THE ETABLISSEMENTS KUHLMANN, of France, have just given an order to the Nitrogen Engineering Corporation, of the United States, to remodel a Casale synthetic ammonia unit for the process and designs of the Nitrogen Engineering Corporation.

MR. J. A. F. ROBERTS AND MR. ARNOLD FROBISHER have returned from a visit to Continental scientific institutions which are carrying on wool research. Their tour was made under the auspices of the British Research Association for the Woollen and Worsted Industries.

DUOCO NITROCELLULOSE LACQUERS, originated by the du Pont de Nemours Co. of America, are being manufactured in France by the Société Française Duco, at Stains, near Paris. A plant for the production of these lacquers is also being erected in the neighbourhood of Turin by the Duco Société Italiana, which will shortly begin production.

UNIVERSITY NEWS.—*London*.—Dr. J. R. Brocklehurst has been appointed lecturer in the Department of Physiology and Biochemistry at University College. Dr. R. W. Lunt has been appointed lecturer in chemistry and Mrs. G. P. Eggleton, assistant in Physiology and Biochemistry. *Oxford*.—At the Encenia, on Wednesday, the honorary degree of D.Sc., was conferred on Lord Melchett.

THE GENERAL COUNCIL of the Trades Union Congress, at a special meeting held on Tuesday, approved by 18 votes to 4 a report of the industrial committee which included support for the establishment of a National Industrial Council of employers and trade union representatives, and it rejected by 15 votes to 6 a notice of motion by Mr. George Hicks that the conversations with the Mond group of employers be terminated forthwith.

THE CHILEAN NITRATE OF SODA EDUCATIONAL BUREAU has offered an annual award of \$5,000 to research workers in North America for outstanding research that will contribute to the fund of knowledge regarding nitrogen in crop production. The award is sponsored by the American Society of Agronomy, an organisation composed of the crop and soil investigators of the Agricultural Colleges and Experiment Stations of the United States and Canada.

MR. WALTER SESSIONS, joint managing director of English China Clays, Ltd., and Mr. W. Goldman, head of the English China Clay Sales Corporation of New York, have been surveying China Clay deposits in Georgia (United States) with a view to their exploitation by the British firm. Interviewed by a New York paper, they are reported to have said that if a large deposit of suitable quality could be found, accessible by railway, then the company would establish a large plant.

AN OUTBREAK of FIRE occurred on Monday afternoon at the premises of the Rational Carbonisation Syndicate, Ltd., 13, Victoria Street, London, due to an unknown cause. The firemen were able to confine the fire to the laboratory in the basement, where a quantity of distilled coal was destroyed. The rest of the contents were slightly damaged by fire, heat, smoke and water, whilst Edward Terence, aged 21 years, was burned on the hands and face, and removed to a hospital.

THE THAMES CONSERVANCY BOARD is reported to have passed the effluent from the Eynsham beet sugar factory, which is employing the drying process worked out by Dr. B. J. Owen, as harmless. The official adviser on sugar of the French Ministry of Agriculture, after a visit to the Eynsham factory (which is operating on the commercial scale), is said to have reported that the discovery may revolutionise the Continental beet-sugar methods. The process enables factories to increase their output threefold.

MR. EDWARD STONE has been appointed to the Board of the British Cement Products and Finance Co.

THE DORR CO., LTD., have appointed Crossle, Scott and Duff, Ltd., of Melbourne, Australia, to act as their agents in Australia and New Zealand.

A POTASH FIELD estimated to contain 2,000 million tons of potassium oxide is stated to have been discovered in the Ural area of Russia.

THE BIRTHPLACE of JUSTUS VON LIEBIG, the eminent German chemist, is being restored in Darmstadt. On July 7 a special opening celebration will be held.

THE TROJAN POWDER PLANT, at Allentown, Pennsylvania, was the scene of a very violent explosion on Thursday, June 21. Four buildings are stated to have been destroyed.

THE NEW ADDRESS of the London office of Hopkinsons, Ltd., is 34, Norfolk Street, Strand, W.C.2. T.N., Central 4541-2-3; telegraphic address, "Valvestem Phone London."

A FACTORY for the production of synthetic camphor, the first of its kind in France, is being built by the Société Anonyme des Produits Chimiques et Matières Colorantes de Mulhouse.

RECENT WILLS INCLUDE:—Mr. Henry Allen, of Windermere, lately a managing director of Bleacher's Association and formerly chairman of the Colour Users' Association, £135,597 (net personality £125,041).

THE ARGENTINE GOVERNMENT is constructing a new sulphuric acid plant, which is about half completed and should be ready at the end of this year. One section will be devoted to the production of aluminium sulphate in crystalline form.

THE PROSPECTUS was published on Tuesday of Waste Food Products, Ltd. Lists in connection with an issue of 105,000 £1 ordinary shares and 105,000 deferred shares of 1s. were opened on Wednesday morning. Cross and Bevan, analytical chemists, London, are to be consulting chemists to the company.

DR. C. E. K. MEES, director of the Eastman Kodak Research Laboratory, will deliver a lecture on "Physics in Photography," arranged by the Institute of Physics in co-operation with the Seventh International Congress of Photography, on Thursday, July 12, at the Institution of Electrical Engineers, London. Sir W. J. Pope will take the chair.

A NEW SYNTHETIC FERTILISER FACTORY, to work by the Haber-Bosch method, is to be erected in Japan. It is reported, with some reserve, that the output of the factory will be equivalent to 30,000 tons of pure nitrogen per year. This development may have important consequences, as Japanese fertilisers would naturally have large advantages in Asia, from the point of view of transport costs, over those deriving from Europe.

AN ISSUE of SHARES was made this week by Acetex Safety Glass, Ltd., which has been formed to acquire the sole licence to manufacture in the United Kingdom and the British Empire (excluding Canada) safety glass under three patent applications. The material, it is stated, will not splinter, does not discolour, is impervious to moisture, contains no inflammable adhesive, and can be made of plate glass or ordinary sheet glass. The directors include Mr. C. Price Williams, M.Sc., a director of Scottish Artificial Silks, Ltd.

ARTIFICIAL SILK NEWS.—Sir Edward Turton has been appointed a director of Harben's (Viscose Silk Manufacturers), Ltd., in the place of Mr. H. E. Garle, who has resigned.—It is stated in Manchester that a new cupra-ammonium company is to be floated shortly.—British Breda Silk, Ltd., which is associated with the International Viscose Co., is stated to have acquired a site of 60 acres in the Derby district for the erection of an artificial silk factory which is to have an annual capacity of 3,000,000 lbs.—The works of British Celanese, where it is stated 14,000 workers are now employed, are being extended to cover a further 32 acres.—The report of the Western Viscose Silk Mills states that the installation of plant was completed last August, but severe troubles were encountered in the early stages of operation. Extensive reconstructions have been carried out, and 11 tons of yarn per week are being produced.—The Snia Viscosa concern has increased its capital from 800 to 1,000 million lire in order to absorb the Società Anonima Italiana Seta Artificiale and the Società Anonima Italiana Fabbriche Viscose, both of Turin. The fusion is retrospective to January 1, 1928.

Obituary

PROFESSOR ABRAM ADAM BRENNEMAN, consulting chemist and chemical engineer, editor (1884-1893) of the *Journal of the American Chemical Society*, in New York, recently, aged 81. He published a considerable amount of research work on explosives, water analysis, etc.

MR. W. H. NICHOLS, JR., president of the General Chemical Co. of the United States, and vice-president of the Allied Chemical and Dye Corporation, on May 26.

References to Current Literature

British

ANALYSIS.—Determination of citronellal in Java citronella oil. *Perfumery and Essential Oil Record*, June 20, pp. 210-212.

Behaviour of indicators in the titration of ammonia, sodium and calcium phosphates, the methylamines, pyridine bases and boric acid. R. T. Thompson. *Analyst*, June, pp. 315-321.

COLOUR.—Colour standardisation and testing in the American paint and colour industry. F. A. Wertz. *J. Oil and Colour Chem. Assoc.*, May, pp. 180-182.

LEAD TETRAETHYL.—The separation of lead tetraethyl from solution in petroleum spirit. F. W. Toms and C. P. Money. *Analyst*, June, pp. 328-329. Lead tetraethyl may be removed from solution in petroleum spirit by the action of sulphur dioxide. The insoluble reaction product, when subjected to a process of "wet combustion," yields relatively pure lead sulphate.

United States

APPARATUS.—Automatic apparatus for the determination of small concentrations of sulphur dioxide in air. M. D. Thomas and R. J. Cross. *Ind. Eng. Chem.*, June, pp. 645-647. An automatic apparatus has been constructed to analyse continuously air containing sulphur dioxide in concentration from 0.1 to 60 p.p.m. The apparatus measures out the absorbing liquid, draws a definite volume of air sample through it, and discharges the aspirated solution into a bottle ready for titration. A modification of the automatic apparatus suitable for field determination of sulphur dioxide in air is described.

GENERAL.—The fish meal industry. J. A. Leblere. *American Fertiliser*, June 9, pp. 19-24, 40, 42, 55-56, 58, 60, 62, 64.

Solid-solution formation in mixtures of paraffin waxes. L. D. Myers and W. G. Stegeman. *Ind. Eng. Chem.*, June, pp. 638-641. Deals with the formation of solid solutions in paraffin waxes and the influence of this property on the separation of oil and wax.

Pumice impregnated with anhydrous magnesium perchlorate as a drying agent. J. H. Yoe, R. W. McGahey, and W. T. Smith. *Ind. Eng. Chem.*, June, pp. 656-657.

Starch products in the paper and textile industries. R. P. Walton. *Amer. Dyestuff Reporter*, June 11, pp. 371-374.

LOW-TEMPERATURE CARBONISATION.—Low-temperature carbonisation of lignites and sub-bituminous coals. J. D. Davis and A. E. Galloway. *Ind. Eng. Chem.*, June, pp. 612-617. Comparative low-temperature assay tests were made on twenty-four sub-bituminous coals and lignites by three different methods: the oil-shale method, developed by the U.S. Bureau of Mines; the Gray and King method, developed in England; and the Franz Fischer method as used in Germany. The writers find that the Franz Fischer method gives the most concordant results.

VITAMINS.—The complex nature of vitamin B as found in wheat and corn. C. H. Hunt. *J. Biol. Chem.*, June, pp. 83-90. Experiments on rats indicate that vitamin B from wheat and corn is composed of at least two vitamins, F and G, having different functions. Both wheat and corn contain approximately the same total amount of vitamins F and G, but are richer in vitamin F than in G.

German

APPARATUS.—New electrically-heated and driven laboratory apparatus. C. Gerhardt. *Chemische Fabrik*, June 20, pp. 378-379.

The unimeter, a new measuring apparatus for chemical work. L. Bloch and G. Frühling. *Chemiker-Zeitung*, June 20, pp. 488-490. This instrument has been designed for the rapid investigation of the optical properties of materials, such as colour, light transmission and reflection, etc.

CELLULOSE ESTERS.—The X-ray diagram of nitrocellulose and acetyl cellulose. St. v. Náray-Szabó and G. v. Susich. *Zeitschrift physikalische Chem.*, Vol. 134, Parts 3-4, pp.

264-270. From the X-ray diagrams of samples of various degrees of esterification, it is inferred that a well-defined lattice is only obtained in fully substituted products.

CORROSION.—Investigations on the action of various types of ethyl alcohol on pure aluminium and on Lantal. H. Röhrig. *Korrosion und Metallschutz*, June, pp. 133-135.

ELECTRICITY.—The significance of electricity for the chemical industry. H. Walde. *Chemische Fabrik*, June 20, pp. 375-377.

GENERAL.—The action of the silent electric discharge on the hydrocarbons of the ethylene series. N. D. Prjanischnikov. *Berichte*, June 13, pp. 1,359-1,363.

The dangers of mercury and of amalgam tooth-stoppings. A. Stock. *Zeitschrift angewandte Chem.*, June 16, pp. 663-672.

A colloidal heat indicator. R. E. Liesegang. *Kolloid-Zeitschrift*, June, pp. 112-114.

OILS.—Cholesterin as the mother-substance of mineral oil. H. N. D. Zelinsky and K. P. Lawrowsky. *Berichte*, June 13, pp. 1,291-1,294.

Some sulphur compounds occurring in transformer oils (mineral oils). E. Ferber. *Zeitschrift angewandte Chem.*, June 16, pp. 680-682.

Contributions to the viscometry of lubricating oils. W. Ostwald and A. Föhre. *Kolloid-Zeitschrift*, June, pp. 166-179.

ORGANIC.—Alkylation and acylation in the presence of titanium tetrachloride. G. Stadnikoff and L. Kaschtanoff. *Berichte*, June 13, pp. 1,389-1,391. Titanium tetrachloride causes condensation to occur between ethers and organic halogen derivatives, on the one hand, and benzene and thiophen on the other.

Aromatic fluorine compounds. II. 4:4'-difluoro-3-aminodiphenyl and 3:4:4'-trifluorodiphenyl. G. Schiemann and E. Bolstad. *Berichte*, June 13, pp. 1,403-1,409. The above compounds have been synthesised. From the amine, a diazonium solution was obtained which yielded dyestuffs when coupled with β -naphthylamine, Schäffer's acid, R acid, and G acid. A further dyestuff was obtained by coupling the molecule of tetrazotised benzidine with 2 molecules of the above amine.

A benzene-model based on the electron theory and the laws of substitution. M. Ullmann. *Zeitschrift angewandte Chem.*, June 16, pp. 674-680.

SYNTHETIC RUBBER.—Investigations on the structure of stretched synthetic rubber. L. Hock and W. Barth. *Zeitschrift physikalische Chem.*, Vol. 134, Parts 3-4, pp. 271-278. The substance investigated was unvulcanised synthetic rubber ("Methylkautschuk W") from the I.G. works at Leverkusen. It is shown that definite X-ray interference phenomena may be obtained from it by working in the cold.

VITAMINS.—Reactions of irradiated ergosterol (vitamin D). A. Steigmann. *Kolloid-Zeitschrift*, June, pp. 165-166.

Miscellaneous

GENERAL.—The use of sodium and potassium bisulphate in agriculture. P. Wagnet. *Revue Produits Chimiques*, June 15, pp. 401-403 (in French).

ORGANIC.—Contribution to the study of diphenylene sulphide. C. Courtot, L. Nicholas, and T. H. Liang. *Comptes Rendus*, June 11, pp. 1,624-1,626 (in French).

Benzyl chloromethyl ether and dibenzyl formal. P. Carré. *Comptes Rendus*, June 11, pp. 1,629-1,630 (in French).

A new synthesis of tropic acid. M. Chambon. *Comptes Rendus*, June 11, pp. 1,630-1,631 (in French).

3:4:5-Trichlorophenol. M. Kohn and R. Kramer. *Monatshefte*, Vol. 49, Part 3, pp. 161-168 (in German).

The reaction between chlorosulphonic acid and phenols. J. Pollak, E. Gebauer-Fülneegg, and E. Blumenstock-Halward. *Monatshefte*, Vol. 49, Part 3, pp. 186-202 (in German).

VITAMINS.—Comparison of the anti-rachitic power of some marine animal oils and of cod liver oil. L. Randoin, E. André, and R. Lecoq. *Journal Pharmacie et Chimie*, June 1, pp. 529-539 (in French).

Patent Literature

The following information is prepared from published Patent Specifications and from the Illustrated Official Journal (Patents) by permission of the Controller to H.M. Stationery Office. Printed copies of full Patent Specifications accepted may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at 1s. each.

Abstracts of Complete Specifications

289,037. DERIVATIVES OF 2:3-OXYNAPHTHOIC AMIDE, MANUFACTURE OF. I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. International Convention date, April 22, 1927.

2:3-oxynaphthoic arylides are obtained by heating 2:3-oxynaphthoic acid with the corresponding aryl mustard oils until evolution of carbon oxysulphide ceases.

291,131. BENZANTHRONE DERIVATIVES, PROCESS FOR THE PRODUCTION OF. J. Y. Johnson, London. From I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. Application date, February 21, 1927.

Bzl-methoxybenzanthrone and its derivatives, which are valuable dyestuffs intermediates, are obtained by treating a benzanthrone containing an interchangeable negative substituent in the Bzl-position, and corresponding derivatives thereof, with methyl alcohol in presence of alkaline reagents. Specified negative substituents are nitro, halogen, sulphonie, and sulphone groups. When nitro-substituted derivatives are employed, the oxidising effect due to the nitrous acid produced is counteracted by addition of sodium sulphite or urea. Fifteen examples are given.

291,137. LIQUID HYDROCARBONS OF LOW BOILING-POINT, PRODUCTION OF, FROM OLEFINES. J. Y. Johnson, London. From I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. Application date, February 22, 1927.

It is known that olefines are convertible by heat with or without pressure into low boiling-point liquid hydrocarbons (including benzene, etc.), but the reaction is slow and the yield is small. The present invention provides a speedier reaction with improved yield by use of one or other of the following types of catalysts: (1) Gold, silver or copper in such form as to exhibit coherent surfaces—e.g., copper or silver turnings or copper gauze are suitable; (2) catalysts containing compounds (preferably oxygen-containing compounds) of the alkali metals, except that the use of catalysts capable of forming methanol is avoided when working under pressure with a gas containing carbon monoxide and hydrogen; (3) metallic salts of oxygen acids of phosphorus, boron, or antimony, or their reduction products, or the free acids in solid form, or their anhydrides on carriers. To counteract the undesirable formation of methane it is advantageous to add methane or gases furnishing methane to the olefine-containing gases.

291,186. SEPARATING AND RECOVERING OLEFINES FROM GASES CONTAINING SAME, PROCESS FOR. Synthetic Ammonia and Nitrates, Ltd., and G. F. Horsley, Billingham, Stockton-on-Tees, Durham. Application date, March 30, 1927.

Mixtures of carbon monoxide and ethylene, such as occur in coal gas, are separated into their constituents by scrubbing the gas, previously freed from sulphur compounds, under normal or increased pressure, with an acid solution of silver nitrate which absorbs only the ethylene. The latter is recovered by heating the solution with or without reduction of pressure. The scrubbing tower is preferably constructed from a resistant steel alloy.

291,244. HYDROGEN, PRODUCTION OF, FROM METHANE HYDROCARBONS. J. Y. Johnson, London. From I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. Application date, June 18, 1927.

Methane and its homologues are converted into hydrogen by means of steam with the aid of catalysts at an elevated temperature, the carbon dioxide simultaneously formed being removed from the reaction mixture by absorption at such high temperatures that no condensation of water vapour takes place. An almost quantitative conversion is thus effected at a lower temperature (400-600° C) than when such condensation is allowed. The absorbent may be lime, but it is preferred to use cerous oxide (at about 110° C.), as this can

be regenerated from the resulting cerous carbonate at a comparatively low temperature (about 350° C.).

291,245. TANNING AGENTS, MANUFACTURE AND PRODUCTION OF. J. Y. Johnson, London. From I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. Application date, June 18, 1927.

The water-soluble condensation products obtainable from phenol or its homologues or halogen derivatives with formaldehyde and salts of sulphurous acid are further condensed with sulphur in presence of alkaline reagents. The alkali may be that liberated by the combination of neutral sulphite with formaldehyde to form formaldehyde bisulphite.

291,249. CHROMIC ACID, MANUFACTURE OF IN A SOLID FORM SOLUBLE IN WATER. R. Schuster, 94, Paulsbornerstrasse, Berlin-Halensee, Germany. Application date, June 23, 1927.

A mixture of chromic anhydride, sulphuric acid and sodium or potassium silicate with water is evaporated to produce a crystalline mass. Sodium or potassium bichromate may be substituted for the chromic anhydride.

291,253. EXOTHERMIC GAS REACTIONS, METHOD OF CARRYING OUT. H. Harter, 8, Theresienstrasse, Würzburg, Germany. Application date, July 4, 1927.

In carrying out exothermic gas reactions in contact with solid catalytic material, the use of large and efficient catalytic apparatus is rendered possible and local overheating is avoided by subdividing the gas supply pipe and distributing the several discharge outlets uniformly over the length of the catalytic tube. Processes and apparatus for the synthesis of ammonia and for the oxidation of ammonia to nitric acid are described and illustrated.

291,277. RECOVERY OF ABSORBABLE SUBSTANCES FROM GASEOUS MIXTURES. E. C. R. Marks, London. From Carbide and Carbon Chemical Corporation, 30, East Forty-second Street, New York, U.S.A. Application date, October 22, 1927.

The invention is primarily directed to the recovery of ether and alcohol from the air circulated through the spinning machines in manufacturing artificial silk by absorbing them in a solid or liquid absorbent, preferably activated carbon, and subsequently expelling the vapours by heat and rectifying and condensing them, and is characterized by arrangements for preventing the disturbing action on the rectifier and condenser of large volumes of air. For this purpose air is expelled from the apparatus before heating the absorbent, and this expulsion is effected by a current of steam which is by-passed so that it does not pass through the absorbent. The condensation of the steam supplies heat for the rectification.

291,326. MONOCARBOXYLIC ACIDS, MANUFACTURE AND PRODUCTION OF. I. G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. Application date, November 22, 1926. Addition to 262,101.

The process according to Specification 262,101 (See THE CHEMICAL AGE, Vol. XVI, p. 144) is modified by the employment as catalysts, capable of splitting off carbon dioxide from the dicarboxylic acids, of the oxides of zinc, cadmium, lead, or bismuth. Such catalysts may be used alone or in admixture with each other or with other oxides, hydroxides, or silicates. Their use is advantageous as resulting in a nearly quantitative yield and as eliminating oxidising action on the monocarboxylic products in presence of oxygen-containing gases. In examples the production of benzoic acid from phthalic acid or phthalic anhydride is described, the catalyst being a mixture of bismuth oxide and alumina precipitated on pumice stone, or zinc oxide in compact particles, or on a carrier such as pumice stone. The process may be continuous with the production of phthalic anhydride from crude naphthalene. The preferred catalysts are prepared by spraying a solution of zinc nitrate with or without nitrates of other metals over slightly-heated pumice and heating to 300-400° C. in a current of air.

NOTE.—Abstracts of the following Specifications, which are now accepted, appeared in THE CHEMICAL AGE when they became open to inspection under the International Convention:—262,101 (I.G. Farbenindustrie Akt.-Ges.) relating to manufacture and production of monocarboxylic acids, see Vol XVI, p. 144; 263,826 (Society of Chemical Industry in Basle) relating to manufacture of dyestuffs, see Vol. XVI, p. 263; 272,469 (I.G. Farbenindustrie Akt.-Ges.) relating to production of anthraquinone derivatives, see Vol XVII, p. 153; 277,382 (R. Von Zelewski) relating to a process for producing sulphur-dioxide-containing gas currents for the manufacture of sulphuric acid, see Vol. XVII, p. 467; 277,702 (H. Schorn) relating to aluminium alloys, see Vol. XVII, p. 47 (Metallurgical Section); 280,226 (Soc. Anon-Union Agricole de Jodoigne) relating to a soluble complete manure, see Vol. XVIII, p. 35; 282,330 (F. G. Liljenroth) relating to a method of producing mixed manures, see Vol. XVIII, p. 150; 283,119 (I.G. Farbenindustrie Akt.-Ges.) relating to manufacture of methylene chloride, see Vol XVIII, p. 225; 283,908 (F. G. Liljenroth) relating to a method of producing mixed manures, see Vol. XVIII, p. 271; 284,272 (G. Walter) relating to manufacture and production of methylol ureas, see Vol. XVIII, p. 305.

International Specifications not yet Accepted

289,092. DYES. I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. International Convention date, April 23, 1927.

Diaminotriphenylmethane dyes are obtained by condensation of a benzaldehydisulphonic acid, *e.g.*, the 2:4- or 2:5- disulphonic acid, with a propylated or higher alkylated aryl amine, *e.g.*, 2-mono-1¹-methylpropylamino-1-methylbenzene or 2-isopropylamino-1-methylbenzene. The dyestuffs are salted out after oxidation of the resulting leuco compound. The alkylarylamines are obtainable from 2-chloropropane, 2-chlorobutane, etc.

289,094. DYES. Soc. of Chemical Industry in Basle, Basle, Switzerland. International Convention date, April 23, 1927.

Chromium compounds of azo dyes giving fast blue dyeings on cotton from a neutral or slightly alkaline bath are obtained by treating with an agent yielding chromium *o*-oxyazo dyestuffs obtained by coupling 5-nitro-2-aminophenol with an N-alkyl, N-aryl, N-alkylene, or N-arylene derivative of 2-amino-5-naphthol-7-sulphonic acid. In an example the dyestuff 5-nitro-2-aminophenol \rightarrow (alkaline) phenyl-2:5:7-acid is boiled under reflux with chromium fluoride solution.

289,097. 1-AMINOANTHRAQUINONE-2-SULPHONIC ACID. I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. International Convention date, April 23, 1927.

1-Aminoanthraquinone sulphonated in presence of a sulphate of an alkali or alkaline earth yields only the 2-sulphonic acid. In an example 1-aminoanthraquinone dissolved in sulphuric acid is heated with fuming sulphuric acid in presence of anhydrous sodium sulphate.

289,383. HYDROFLUORIC ACID. Verein für Chemische und Metallurgische Produktion, Aussig-on-Elbe, Czechoslovakia. International Convention date, April 25, 1927.

The vapours containing hydrofluoric acid and silicon fluoride obtained by the action of sulphuric acid on fluor spar are treated for the extraction of hydrofluoric acid substantially free from silicon compounds. The water vapour is removed and the substantially anhydrous hydrofluoric acid is condensed. The first fractions, containing hydrofluosilicic acid may be used to form aluminium fluoride for conversion into cryolite. The removal of the water vapour may be effected by fractional condensation or by passage over concentrated sulphuric acid or a sulphate dehydrating agent.

289,387. NITROCELLULOSE. I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. International Convention date, April 25, 1927.

Nitrocelluloses yielding solutions of low viscosity are obtained by heating unstable nitrocelluloses, which yield highly viscous solutions, with water at a temperature above 100° C. in presence of an insoluble base such as magnesia.

289,391. STORING GASES. Soc. l'Air Liquide, Soc. Anon. pour l'Etude et l'Exploitation des Procédés G. Claude, 48, Rue St. Lazare, Paris. International Convention date, April 26, 1927.

For the safe storage of gases under pressure, particularly acetylene in solution, porous fillings are employed comprising (1) pieces of charcoal of the largest size that can be introduced into the container and of such a shape as to reduce the space between the pieces to a minimum, and (2) pulverulent material, *e.g.*, charcoal, which can assume, by simple settling, a sufficient density to avoid propagation of explosions.

289,412. NITROGEN OXIDES. Elektrizitätswerk Lonza, 72. Aeschenvorstadt, Basle, Switzerland. International Convention date, April 26, 1927.

Gaseous mixtures such as are obtained by the oxidation of nitrogen or ammonia are treated in stages, *e.g.*, in centrifugal washers, with nitric acid of increasing concentration at temperatures below 0° C. (preferably—20° C. to 30° C.) for absorption of the oxides of nitrogen. Nitrogen peroxide produced in the earlier stages by the action of the lower oxides on the nitric acid is absorbed in the more concentrated acid in the later stages. The liquid from the earlier stages may be treated with oxygen to reconvert it into nitric acid, and that from the final stage may be separated into concentrated nitric acid and pure nitrogen peroxide by fractional distillation.

289,414-5. MODIFYING SUBSTANCES (OILS, RESINS, RUBBER, ETC.) CONTAINING UNSATURATED CARBON COMPOUNDS. L. Auer, 42, Jokai Utcza, Budapest. International Convention date, April 26, 1927.

289,414. The treatment of products containing unsaturated carbon compounds with a metal, an oxide or hydroxide, or an organic base is combined with a simultaneous or subsequent sulphurising treatment. The sulphur or sulphur chloride employed may be used in solution or the solvent may be added to the reaction mixture. Accelerators may be added, and plastic products may be obtained by addition of fillers. In examples are described the preparation from castor oil of a product moulded under pressure, and the preparation of a varnish-like material from rosin.

289,415. The treatment of products containing unsaturated carbon compounds with electrolytes to modify their physical properties is effected by means of a solution or colloidal solution of the electrolyte in an organic solvent, the electrolytes employed being organic or inorganic acids, their salts or esters, metallic derivatives of organic compounds, metal oxides or hydroxides, or organic bases. The products, with the addition, if necessary, of fillers, pigments, or solvents, may be utilised for the preparation of varnishes, linoleums, rubbers, candles, and soaps.

289,418. ADSORBENTS; SILICA GELS. A. Rosenheim, 3, Carmerstrasse, Charlottenburg, Berlin. International Convention date, April 27, 1927. Addition to 275,203.

The preparation of adsorbents as described in the parent Specification, by treatment of natural or artificial zeolites with acids, is so effected that a sol is produced and is converted into a gel without separation of the electrolytes such as aluminium chloride or ferric chloride. The electrolytes may be removed by water or acids after drying the gel. Alternatively a silicic acid sol may be treated with electrolytes such as aluminium chloride before conversion into a gel, or a gel mixture of, for instance, silica and alumina, iron, magnesium, or titanium, may be treated with acid to remove the alumina, etc., or a silica gel may be treated with a solution of aluminium or ferric chloride which is washed out from the dried gel.

LATEST NOTIFICATIONS.

292,137. Method and apparatus for treating solutions. Naugatuck Chemical Co. June 15, 1927.

292,140. Desensitising of photographic plates or films. I.G. Farbenindustrie Akt.-Ges. June 15, 1927.

292,098. Fertilisers. I.G. Farbenindustrie Akt.-Ges. June 13, 1927.

292,100. Process of producing azo-dyestuffs on the fibre. I.G. Farbenindustrie Akt.-Ges. June 13, 1927.

292,103. Manufacture and production of artificial rubber. I.G. Farbenindustrie Akt.-Ges. June 13, 1927.

292,129. Manufacture of ammonium salts. Montecatini Soc. Generale Per L'Industria Mineraria E. Agricola. June 14, 1927.

- 292,133. Process for obtaining sterols. Soc. of Chemical Industry in Basle. June 14, 1927.
 292,168. Manufacture of new condensation products. Soc. of Chemical Industry in Basle. June 16, 1927.

Specifications Accepted with Date of Application

- 263,873. Sulphonic acids, Manufacture of. R. Sajitz and E. Pott (trading as Chemische Fabrik Pott and Co.). December 31, 1926.
 265,233. Esters, Manufacture and production of. I.G. Farbenindustrie Akt.-Ges. January 29, 1926.
 267,132. Side-chain bearing polynuclear aromatic compounds or their sulphonic acids, Manufacture and production of. I.G. Farbenindustrie Akt.-Ges. March 3, 1926.
 267,940. Condensation products from aromatic hydrocarbons or derivatives thereof, Manufacture of. I.G. Farbenindustrie Akt.-Ges. March 16, 1926.
 271,523. Hydrogen, Catalytic process for the manufacture of. R. J. A. Grenier. May 22, 1926.
 274,104. Sulphonation products from fats, oils, or their acids, Obtaining. H. T. Böhme Akt.-Ges. and H. Bertsch. July 8, 1926.
 275,927. Benzanthrone derivatives, Manufacture and production of. I.G. Farbenindustrie Akt.-Ges. August 10, 1926.
 280,999. Lactic acid, Purification of. W. Klapproth. November 22, 1927.
 281,675. Liquefying and separating the constituents of gaseous mixtures at low temperatures. Soc. Air Liquide, Soc. Anon. pour l'Etude et l'Exploitation des Procédés G. Claude. December 4, 1926.
 284,248. Roasting and/or sintering of fine ore or other fine material. Compagnie des Metaux Averbelt-Lommel. January 26, 1927.
 288,127. Acid- and lime-resisting derivatives of unsaturated fatty acids, Manufacture of. I.G. Farbenindustrie Akt.-Ges. April 1, 1927.
 291,810. Purifying colloidal liquids, emulsions, and the like. Process and apparatus for. M. G. W. Hummelinck. December 8, 1926.
 291,814. Anthraquinone derivatives, Manufacture of. British Dyestuffs Corporation, Ltd., A. Shepherdson, W. W. Tatum, and F. Lodge. December 13, 1926.
 291,817. Purification or separation of mixtures of fatty or mineral oils. J. Y. Johnson (I.G. Farbenindustrie Akt.-Ges.). January 7, 1927.
 291,822. Reducing ores, Method of. H. G. C. Fairweather (Nybergs Grufaktiebolag). January 31, 1927.
 291,823. Purifying mineral and naphtha oils. G. Petroff. February 1, 1927.
 291,825. New vat dyestuffs containing sulphur, Manufacture of. K. Carpmal and K. S. Carpmal (I.G. Farbenindustrie Akt.-Ges.). February 3, 1927.
 291,827. Dyestuffs, Treatment of. D. Gardner. February 5, 1927.
 291,832. Gases arising from the distillation of coal and the like, Treatment of. C. Cooper. February 11, 1927.
 291,836. Distillation of coal and other solid carbonaceous materials. T. A. Goskar. March 1, 1927.
 291,849 and 292,056-8. Wax-like mixtures of substances, Manufacture of. British Dyestuffs Corporation, Ltd., J. B. Payman, and W. Gibson. March 4, 1927.
 291,850. Easily soluble derivatives of meta-aminobenzoic acid esters, Preparation of. G. B. Ellis (Chemical Works, formerly Sandoz). March 4, 1927.
 291,851. Dyestuffs of the anthracene series, Manufacture of. O. Y. Imray (I.G. Farbenindustrie Akt.-Ges.). March 7, 1927.
 291,867. Olefines, Production of. A. W. Nash, A. R. Bowen and O. C. Elvins. March 9, 1927.
 291,878. Vat dyestuffs of the anthraquinone series, Process for the manufacture of. K. Carpmal and K. S. Carpmal (I.G. Farbenindustrie Akt.-Ges.). March 10, 1927.
 291,886. Nitration of anthrone and the preparation of 2:7-dinitroanthraquinone. K. Carpmal and K. S. Carpmal (I.G. Farbenindustrie Akt.-Ges.). March 11, 1927.
 291,887. Triphenylmethane dyestuffs, Manufacture of. K. Carpmal and K. S. Carpmal (I.G. Farbenindustrie Akt.-Ges.). March 11, 1927.
 291,888. Dyestuffs from indoline bases, Manufacture of. K. Carpmal and K. S. Carpmal (I.G. Farbenindustrie Akt.-Ges.). March 11, 1927.
 291,919. Pyritic ores (fresh or weathered), imperfectly roasted residues, regulus, mattes, hardheads, and other metallurgical products containing tin and/or compounds of other metals, such as lead, zinc, copper, bismuth, tungsten, antimony, iron, and associated base and precious metals, Treatment of. F. L. Wilder, E. Morris, F. Schiff, and E. S. King. April 6, 1927.
 291,962. Carbonizing coal, Method of. S. Dunlop (M. J. McQuade). June 14, 1927.
 291,965. Naphthalene derivatives, Manufacture of. O. Y. Imray (I.G. Farbenindustrie Akt.-Ges.). June 16, 1927.
 291,991. Dextrose, Manufacture of. E. C. R. Marks (Corn Products Refining Co.). August 19, 1927.
 292,039. Activated charcoal or carbon, Manufacture of. Metallbank und Metallurgische Ges. Akt.-Ges. January 4, 1928.
 292,059. Esters, Manufacture and production of. I.G. Farbenindustrie Akt.-Ges. January 31, 1927. Addition to 265,233.
 292,060. Distillation of solid carbonaceous materials. H. Nielsen and B. Laing. December 4, 1926.

Applications for Patents

- Bogdandy, S. von. Synthesis of chemical substances. 18,051. June 21. (Germany, July 2, 1927.)
 British Celanese, Ltd., Ellis, G. H., Mosby, D. H., and Olpin, H. C. Manufacture of dyestuffs, etc. 17,588. June 18.
 British Celanese, Ltd., Ellis, G. H., Mosby, D. H., and Olpin, H. C. Manufacture of organic compounds. 17,589, 17,590. June 18.
 British Celanese, Ltd., Ellis, G. H., Mosby, D. H., and Olpin, H. C. Materials comprising cellulose derivatives. 17,712. June 19.
 British Celanese, Ltd., Ellis, G. H., Mosby, D. H., and Olpin, H. C. Treatment of cellulosic materials. 18,075. June 22.
 British Glues and Chemicals, Ltd. Conveyers. 17,998. June 21.
 Carpmal, A., and I.G. Farbenindustrie Akt.-Ges. Manufacture of vat dyestuffs. 17,751. June 10.
 Carpmal, A., and I.G. Farbenindustrie Akt.-Ges. Manufacture of ortho-carboxyamido-arylthioglycolic acids. 17,752. June 19.
 Carpmal, A., and I.G. Farbenindustrie Akt.-Ges. Manufacture of azo dyestuffs. 18,249. June 23.
 Commercial Alcohol Co., Ltd. Preparation of glucose. 18,167, 18,168. June 22. (Germany, June 25, 1927.)
 Du Pont de Nemours and Co., E. I. Catalytic synthesis of aliphatic alcohols. 18,180. June 22.
 Heyl, G. E. Production of cellulose acetate. 17,978. June 21.
 I.G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Production of rubber. 17,721. June 19.
 I.G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Purification of gases, etc. 17,871. June 20.
 I.G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Purification of synthetic butyl alcohol. 17,872. June 20.
 I.G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Production of gases. 18,006. June 21. (April 2, 1927.)
 I.G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Alloys resistant to chemical action. 18,007, 18,008. June 21. (June 30, 1927.)
 I.G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Manufacture of highly concentrated nitric acid. 18,009. June 21.
 I.G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Manufacture of vulcanised rubber. 18,128. June 22.
 I.G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Refining crude solutions of sugars, etc. 18,259. June 23.
 I.G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Process for treating granular materials, etc. 18,260. June 23.
 I.G. Farbenindustrie Akt.-Ges. Drying-apparatus. 17,745. June 19. (Germany, June 30, 1927.)
 I.G. Farbenindustrie Akt.-Ges. Colouring, sizing, etc., paper. 18,148. June 22. (Germany, June 29, 1927.)
 I.G. Farbenindustrie Akt.-Ges. Apparatus for recovering volatile solutions. 18,149. June 22. (Germany, June 22, 1927.)
 I.G. Farbenindustrie Akt.-Ges. Manufacture of alkylamine diamines. 18,191. June 22. (Germany, June 23, 1927.)
 I.G. Farbenindustrie Akt.-Ges. Manufacture of 4-amino-1-oxybenzene, etc. 18,268. June 23. (Germany, July 12, 1927.)
 Imperial Chemical Industries, Ltd. Production of granular fertilisers. 17,668. June 10.
 Imperial Chemical Industries, Ltd. Destruction, etc., of solid carbonaceous material. 18,157. June 22.
 Polanyi, M. Synthesis of chemical substances. 18,051. June 21. (Germany, July 2, 1927.)
 Poore, P. Production of acetic acid, etc. 18,025. June 21.
 Soc. of Chemical Industry in Basle. Manufacture of dyestuffs. 18,267. June 23. (Switzerland, June 24, 1927.)
 Stell, J. R., Stell, S., and Stell and Sons, J. Dyeing yarns, etc. 18,217. June 23.
 Warburton, T. Production of acid sulphate of alpha-naphthylamine. 17,649. June 19.

Spanish Production of Pyrites

THE pyrites mines of Spain supply at present more than half of the world production. In 1926, the world production was 6.2 million tons, and that of Spain 3,305,000 tons. The most important Spanish sources are worked by the British Rio Tinto and Tharsis concerns. In Rio Tinto the daily production is 7,000 tons, of which 5,000 tons are exported, 1,000 tons roasted, and 1,000 tons worked up for the copper content. The copper content of the pyrites seems to be on the decline, and new experimental plant has been erected to work out new methods for pyrites poor in copper, which in some mines occurs in large quantities.

Weekly Prices of British Chemical Products

The prices and comments given below respecting British chemical products are based on direct information supplied by the British manufacturers concerned. Unless otherwise qualified, the figures quoted apply to fair quantities, net and naked at makers' works.

General Heavy Chemicals

ACID ACETIC, 40% TECH.—£19 per ton.
 ACID BORIC, COMMERCIAL.—Crystal, £30 per ton; powder, £32 per ton; extra fine powder, £34 per ton.
 ACID HYDROCHLORIC.—3s. 9d. to 6s. per carboy d/d, according to purity, strength, and locality.
 ACID NITRIC, 80° Tw.—£21 10s. to £27 per ton, makers' works, according to district and quality.
 ACID SULPHURIC.—Average National prices f.o.r. makers' works, with slight variations up and down owing to local considerations; 140° Tw., Crude Acid, 60s. per ton. 168° Tw., Arsenical, £5 10s. per ton. 168° Tw., Non-arsenical, £6 15s. per ton.
 AMMONIA ALKALI.—£6 15s. per ton f.o.r. Special terms for contracts.
 BISULPHITE OF LIME.—£7 10s. per ton, f.o.r. London, packages extra.
 BLEACHING POWDER.—Spot, £9 10s. per ton d/d; Contract, £8 10s. per ton d/d, 4-ton lots.
 BORAX, COMMERCIAL.—Crystals, £19 10s. to £20 per ton; granulated, £19 per ton; powder, £21 per ton. (Packed in 2-cwt. bags carriage paid any station in Great Britain.)
 CALCIUM CHLORIDE (SOLID).—£5 to £5 5s. per ton d/d carr. paid.
 COPPER SULPHATE.—£25 to £25 10s. per ton.
 METHYLATED SPIRIT 61 O.P.—Industrial, 1s. 6d. to 1s. 11d. per gall.; pyridinised industrial, 1s. 8d. to 2s. 1d. per gall.; mineralised, 2s. 7d. to 2s. 11d. per gall.; 64 O.P., 1d. extra in all cases.
 NICKEL SULPHATE.—£38 per ton d/d.
 NICKEL AMMONIA SULPHATE.—£38 per ton d/d.
 POTASH CAUSTIC.—£30 to £33 per ton.
 POTASSIUM BICHROMATE.—4½d. per lb.
 POTASSIUM CHLORATE.—3½d. per lb., ex wharf, London, in cwt. kegs.
 SALAMMONIAC.—£45 to £50 per ton d/d. Chloride of ammonia, £37 to £45 per ton, carr. paid.
 SALT CAKE.—£3 15s. to £4 per ton d/d. In bulk.
 SODA CAUSTIC, SOLID.—Spot lots delivered, £15 2s. 6d. to £18 per ton, according to strength; 20s. less for contracts.
 SODA CRYSTALS.—£5 to £5 5s. per ton, ex railway depots or ports.
 SODIUM ACETATE 97/98%.—£21 per ton.
 SODIUM BICARBONATE.—£10 10s. per ton, carr. paid.
 SODIUM BICHROMATE.—3½d. per lb.
 SODIUM BISULPHITE POWDER, 60/62%.—£17 10s. per ton delivered for home market, 1-cwt. drums included; £15 10s. f.o.r. London.
 SODIUM CHLORATE.—2½d. per lb.
 SODIUM NITRITE, 100% BASIS.—£27 per ton d/d.
 SODIUM PHOSPHATE.—£14 per ton, f.o.b. London, casks free.
 SODIUM SULPHATE (GLAUBER SALTS).—£3 12s. 6d. per ton.
 SODIUM SULPHIDE CONC. SOLID, 60/65.—£13 5s. per ton d/d. Contract, £13. Carr. paid.
 SODIUM SULPHIDE CRYSTALS.—Spot, £8 12s. 6d. per ton d/d. Contract, £8 10s. Carr. paid.
 SODIUM SULPHITE, PEA CRYSTALS.—£14 per ton f.o.b. London, 1-cwt. kegs included.

Coal Tar Products

ACID CARBOLIC CRYSTALS.—6½d. to 6½d. per lb. Crude 60's, 2s. 3d. to 2s. 4d. per gall. prompt.
 ACID CRESYLIC 99/100.—2s. 8d. to 3s. per gall. 97/99.—2s. 7d. to 2s. 8d. per gall. Pale, 95%, 2s. 3d. to 2s. 6d. per gall. Dark, 2s. 2d. to 2s. 4d.
 ANTHRACENE.—A quality, 2½d. per unit. 40%, £5 per ton.
 ANTHRACENE OIL, STRAINED.—8d. to 8½d. per gall. Unstrained, 7½d. to 8d. per gall.
 BENZOLE.—Prices at works: Crude, 10½d. to 11d. per gall.; Standard Motor, 1s. 4½d. to 1s. 5d. per gall.; 90%, 1s. 7d. to 1s. 8d. per gall.; Pure, 1s. 10d. to 1s. 11d. per gall.
 TOLUOLE.—90%, 1s. 7d. to 2s. per gall. Firm. Pure, 1s. 10d. to 2s. 2d. per gall.
 XYLOL.—1s. 1d. to 1s. 11d. per gall. Pure, 2s. 3d. per gall.
 CREOSOTE.—Cresylic, 20/24%, 9d. per gall.; middle oil, 7d. to 8d. per gall. Heavy, 8d. to 8½d. per gall. Standard specification, 6½d. to 7d. ex works. Salty, 7½d. per gall.
 NAPHTHA.—Crude, 8½d. to 9d. per gall. Solvent 90/160, 1s. 1d. to 1s. 2d. per gall. Solvent 95/160, 1s. 2d. to 1s. 7d. per gall. Solvent 90/190, 9½d. to 1s. 4d. per gall.
 NAPHTHALENE CRUDE.—Drained Creosote Salts, £4 10s. to £5 per ton. Whizzed, £8 per ton. Hot pressed, £8 10s. to £9 per ton.
 NAPHTHALENE.—Crystals, £13 to £14 10s. per ton. Quiet. Flaked, £13 to £15 per ton, according to districts.
 PITCH.—Medium soft, 57s. 6d. to 65s. per ton, f.o.b., according to district. Nominal.
 PYRIDINE.—90/140, 5s. to 6s. per gall. 90/180, 3s. to 4s. 6d. per gall. Heavy, 2s. 6d. to 3s. per gall.

Intermediates and Dyes

In the following list of Intermediates delivered prices include packages except where otherwise stated:
 ACID AMIDONAPHTHOL DISULPHO (1-8-2-4).—10s. 9d. per lb.
 ACID ANTHRANILIC.—6s. per lb. 100%.
 ACID BENZOIC.—1s. 8½d. per lb.
 ACID GAMMA.—4s. 6d. per lb.
 ACID H.—3s. per lb.
 ACID NAPHTHIONIC.—1s. 6d. per lb.
 ACID NEVILLE AND WINTHER.—4s. 9d. per lb.
 ACID SULPHANILIC.—8½d. per lb.
 ANILINE OIL.—8d. per lb. naked at works.
 ANILINE SALTS.—8d. per lb. naked at works.
 BENZALDEHYDE.—2s. 3d. per lb.
 BENZIDINE BASE.—3s. 3d. per lb. 100% basis d/d.
 BENZOIC ACID.—1s. 8½d. per lb.
 o-CRESOL 29/31° C.—5½d. per lb.
 m-CRESOL 98/100%.—2s. 3d. to 2s. 6d. per lb.
 p-CRESOL 32/34° C.—2s. 3d. to 2s. 6d. per lb.
 DICHLORANILINE.—2s. per lb.
 DIMETHYLANILINE.—1s. 11d. per lb.
 DINITROBENZENE.—8½d. per lb. naked at works. £75 per ton.
 DINITROCHLOROBENZENE.—£84 per ton d/d.
 DINITROTOLUENE.—48/50° C. 8d. per lb. naked at works. 66/68° C. 9d. per lb. naked at works.
 DIPHENYLAMINE.—2s. 10d. per lb. d/d.
 a-NAPHTHOL.—2s. per lb. d/d.
 B-NAPHTHOL.—10d. per lb. d/d.
 a-NAPHTHYLAMINE.—1s. 3d. per lb.
 B-NAPHTHYLAMINE.—3s. per lb.
 o-NITRANILINE.—5s. 9d. per lb.
 m-NITRANILINE.—3s. per lb. d/d.
 p-NITRANILINE.—1s. 8d. per lb.
 NITROBENZENE.—6d. per lb. naked at works.
 NITRONAPHTHALENE.—1s. 3d. per lb.
 R. SALT.—2s. 2d. per lb.
 SODIUM NAPHTHIONATE.—1s. 8½d. per lb. 100% basis d/d.
 o-TOLUIDINE.—8d. per lb.
 p-TOLUIDINE.—1s. 10d. per lb. naked at works.
 m-XYLIDINE ACETATE.—2s. 6d. per lb. 100%.
 N. W. ACID.—4s. 9d. per lb. 100%.

Wood Distillation Products

ACETATE OF LIME.—Brown, £10 5s. per ton. Good demand.
 Grey, £14 10s. to £15 per ton. Liquor, 9d. per gall.
 CHARCOAL.—£6 to £9 per ton, according to grade and locality.
 Foreign competition severe.
 IRON LIQUOR.—1s. 3d. per gall, 32° Tw. 1s. per gall. 24° Tw.
 RED LIQUOR.—9d. to 10d. per gall.
 WOOD CREOSOTE.—1s. 9d. per gall. Unrefined.
 WOOD NAPHTHA, MISCIBLE.—3s. 11d. to 4s. 3d. per gall. Solvent, 4s. 3d. per gall.
 WOOD TAR.—£4 to £5 per ton.
 BROWN SUGAR OF LEAD.—£40 15s. per ton.

Rubber Chemicals

ANTIMONY SULPHIDE.—Golden, 6½d. to 1s. 5½d. per lb., according to quality; Crimson, 1s. 4d. to 1s. 6d. per lb., according to quality.
 ARSENIC SULPHIDE, YELLOW.—1s. 9d. per lb.
 BARYTES.—£3 10s. to £6 15s. per ton, according to quality.
 CADMIUM SULPHIDE.—2s. 6d. to 2s. 9d. per lb.
 CARBON BISULPHIDE.—£20 to £25 per ton, according to quantity.
 CARBON BLACK.—5½d. per lb., ex wharf.
 CARBON TETRACHLORIDE.—£45 to £50 per ton, according to quantity. drums extra.
 CHROMIUM OXIDE, GREEN.—1s. 1d. per lb.
 DIPHENYLGUANIDINE.—3s. 9d. per lb.
 INDIARUBBER SUBSTITUTES, WHITE AND DARK.—5½d. to 6½d. per lb.
 LAMP BLACK.—£35 per ton, barrels free.
 LEAD HYPOSULPHITE.—9d. per lb.
 LITHOPHONE, 30%.—£22 10s. per ton.
 MINERAL RUBBER "RUBPRON".—£13 12s. 6d. per ton, f.o.r. London.
 SULPHUR.—£9 to £11 per ton, according to quality.
 SULPHUR CHLORIDE.—4d. to 7d. per lb., carboys extra.
 SULPHUR PRECIP. B.P.—£47 10s. to £50 per ton.
 THIOCARBAMIDE.—2s. 6d. to 2s. 9d. per lb., carriage paid.
 THIOCARBANILIDE.—2s. 1d. to 2s. 3d. per lb.
 VERMILION, PALE OR DEEP.—6s. to 6s. 3d. per lb.
 ZINC SULPHUR.—1s. per lb.

Pharmaceutical and Photographic Chemicals

ACID, ACETIC, PURE, 80%.—£39 per ton ex wharf London in glass containers.
 ACID, ACETYL SALICYLIC.—2s. 7d. to 2s. 8d. per lb.
 ACID, BENZOIC, B.P.—2s. to 3s. 3d. per lb., according to quantity.
 Solely ex Gum, 1s. 3d. to 1s. 4d. per oz., according to quantity.

- ACID, BORIC B.P.—Crystal, 36s. to 39s. per cwt.; powder, 40s. to 43s. per cwt.; extra fine powder, 42s. per cwt., according to quantity. Carriage paid any station in Great Britain, in ton lots.
- ACID, CAMPHORIC.—19s. to 21s. per lb.
- ACID, CITRIC.—1s. 10½d. to 1s. 11½d. per lb. Less 5%.
- ACID, GALLIC.—2s. 8d. per lb. for pure crystal, in cwt. lots.
- ACID, PYROGALLIC, CRYSTALS.—7s. 3d. per lb. Resublimed, 8s. 3d. per lb.
- ACID, SALICYLIC, B.P. PULV.—1s. 4½d. to 1s. 6d. per lb. Technical.—10½d. to 11½d. per lb.
- ACID, TANNIC B.P.—2s. 8d. to 2s. 10d. per lb.
- ACID, TARTARIC.—1s. 4½d. per lb., less 5%.
- ACETANILIDE.—1s. 5d. to 1s. 8d. per lb. for quantities.
- AMIDOL.—7s. 6d. to 9s. per lb., d/d.
- AMIDOPYRIN.—8s. to 8s. 3d. per lb.
- AMMONIUM BENZOATE.—3s. 3d. to 3s. 6d. per lb., according to quantity. 18s. per lb. ex Gum.
- AMMONIUM CARBONATE B.P.—£37 per ton. Powder, £39 per ton in 5 cwt. casks. Resublimed, 1s. per lb.
- ATROPINE SULPHATE.—9s. per oz.
- BARBITONE.—5s. 9d. to 6s. per lb.
- BENZONAPHTHOL.—3s. 3d. per lb. spot.
- BISMUTH CARBONATE.—11s. 4d. to 11s. 7d. per lb.
- BISMUTH CITRATE.—10s. 4d. to 10s. 7d. per lb.
- BISMUTH SALICYLATE.—10s. 7d. to 10s. 10d. per lb.
- BISMUTH SUBNITRATE.—9s. 7d. to 9s. 10d. per lb.
- BISMUTH NITRATE.—6s. 7d. to 6s. 10d. per lb.
- BISMUTH OXIDE.—14s. 7d. to 14s. 10d. per lb.
- BISMUTH SUBCHLORIDE.—14s. 4d. to 14s. 7d. per lb.
- BISMUTH SUBGALLATE.—8s. 7d. to 8s. 10d. per lb. Extra and reduced prices for smaller and larger quantities of all bismuth salts respectively.
- BISMUTH ET AMMON LIQUOR.—Cit. B.P. in W. Qts. 1s. 1½d. per lb.; 12 W. Qts. 1s. 0½d. per lb.; 36 W. Qts., 1s. per lb.
- BORAX B.P.—Crystal, 24s. to 27s. per cwt.; powder, 25s. to 28s. per cwt., according to quantity. Carriage paid any station in Great Britain, in ton lots.
- BROMIDES.—Ammonium, 1s. 11½d. to 2s. 1d. per lb.; potassium, 1s. 8½d. to 1s. 9½d. per lb.; sodium, 1s. 10½d. to 2s. per lb.; granulated, ½d. per lb. less; all spot. Large quantities at lower rates.
- CALCIUM LACTATE.—1s. 2d. to 1s. 3d. per lb.
- CAMPHOR.—Refined flowers, 2s. 11d. to 3s. per lb., according to quantity; also special contract prices.
- CHLORAL HYDRATE.—3s. 2d. to 3s. 4d. per lb.
- CHLOROFORM.—2s. 4½d. to 2s. 7½d. per lb., according to quantity.
- CREOSOTE CARBONATE.—6s. per lb.
- ETHERS.—S.G. 730—11½d. to 1s. 0½d. per lb., according to quantity; other gravities at proportionate prices.
- FORMALDEHYDE.—£39 per ton, in barrels ex wharf.
- GUALACOL CARBONATE.—4s. 9d. to 5s. per lb.
- HEXAMINE.—2s. 3d. to 2s. 6d. per lb.
- HOMATROPINE HYDROBROMIDE.—30s. per oz.
- HYDRASTINE HYDROCHLORIDE.—English make offered at 120s. per oz.
- HYDROGEN PEROXIDE (12 VOLS.).—1s. 4d. per gallon, f.o.r. makers' works, naked. Winchesters, 2s. 11d. per gall. B.P., 10 vols., 2s. to 2s. 3d. per gall.; 20 vols., 4s. per gall.
- HYDROQUINONE.—3s. 9d. to 4s. per lb., in cwt. lots.
- HYPOPHOSPHITES.—Calcium, 3s. 6d. per lb., for 28 lb. lots; potassium, 4s. 1d. per lb.; sodium, 4s. per lb.
- IRON AMMONIUM CITRATE.—B.P., 2s. 6d. to 2s. 9d. per lb. Green, 2s. 9d. to 3s. 2d. per lb.; U.S.P., 2s. 7d. to 2s. 10d. per lb.
- IRON PERCHLORIDE.—18s. to 20s. per cwt., according to quantity.
- IRON QUININE CITRATE.—B.P., 8½d. to 9½d. per oz.
- MAGNESIUM CARBONATE.—Light commercial, £31 per ton net.
- MAGNESIUM OXIDE.—Light commercial, £62 10s. per ton, less 2½%; Heavy commercial, £21 per ton, less 2½%; in quantity lower; Heavy Pure, 2s. to 2s. 3d. per lb., in 1 cwt. lots.
- MENTHOL.—A.B.R. recrystallised B.P., 16s. per lb. net for January delivery; Synthetic, 9s. to 10s. per lb.; Synthetic detached crystals, 9s. to 12s. 6d. per lb., according to quantity; Liquid (95%), 9s. 6d. per lb.
- MERCURIALS B.P.—Up to 1 cwt. lots, Red Oxide, 7s. 6d. to 7s. 7d. per lb., levig., 7s. to 7s. 1d. per lb.; Corrosive Sublimate, Lump, 5s. 9d. to 5s. 10d. per lb., Powder, 5s. 2d. to 5s. 3d. per lb.; White Precipitate, Lump, 5s. 11d. to 6s. per lb., Powder, 6s. to 6s. 1d. per lb., Extra Fine, 6s. 1d. to 6s. 2d. per lb.; Calomel, 6s. 4d. to 6s. 5d. per lb.; Yellow Oxide, 6s. 10d. to 6s. 11d. per lb.; Persulph., B.P.C., 6s. 1d. to 6s. 2d. per lb.; Sulph. nig., 5s. 10d. to 5s. 11d. per lb. Special prices for larger quantities.
- METHYL SALICYLATE.—1s. 5d. to 1s. 9d. per lb.
- METHYL SULPHONAL.—9s. to 9s. 3d. per lb.
- METOL.—9s. to 11s. 6d. per lb. British make.
- PARA-FORMALDEHYDE.—1s. 9d. per lb. for 100% powder.
- PARALDEHYDE.—1s. 1d. to 1s. 4d. per lb.
- PHENACETIN.—2s. 6d. to 2s. 9d. per lb.
- PHENAZONE.—4s. to 4s. 3d. per lb.
- PHENOLPHTHALEIN.—6s. to 6s. 3d. per lb.
- POTASSIUM BITARTRATE 99/100% (Cream of Tartar).—98s. per cwt., less 2½ per cent.
- POTASSIUM CITRATE.—B.P.C., 2s. 4d. to 2s. 7d. per lb.; U.S.P., 2s. 3d. to 2s. 6d. per lb.
- POTASSIUM FERRICYANIDE.—1s. 9d. per lb., in cwt. lots.
- POTASSIUM IODIDE.—16s. 8d. to 17s. 2d. per lb., according to quantity.
- POTASSIUM METABISULPHITE.—6d. per lb., 1-cwt. kegs included, f.o.r. London.
- POTASSIUM PERMANGANATE.—B.P. crystals, 5½d. per lb., spot.
- QUININE SULPHATE.—1s. 8d. to 1s. 9d. per oz., bulk in 100 oz. tins.
- RESORCIN.—2s. 10d. to 3s. per lb., spot.
- SACCHARIN.—47s. per lb.; in quantity lower.
- SALOL.—2s. 4d. per lb.
- SODIUM BENZOATE, B.P.—1s. 8d. to 1s. 11d. per lb.
- SODIUM CITRATE, B.P.C., 1911—2s. 1d. to 2s. 4d. per lb., B.P.C. 1923—2s. 6d. to 2s. 7d. per lb. U.S.P., 2s. 4d. to 2s. 7d. per lb., according to quantity.
- SODIUM FERROCYANIDE.—4d. per lb., carriage paid.
- SODIUM HYPOSULPHITE, PHOTOGRAPHIC.—£15 per ton, d/d consignee's station in 1-cwt. kegs.
- SODIUM NITROPRUSSIDE.—16s. per lb.
- SODIUM POTASSIUM TARTRATE (ROCHELLE SALT).—95s. to 100s. per cwt. Crystals, 5s. per cwt. extra.
- SODIUM SALICYLATE.—Powder, 1s. 7d. to 1s. 9d. per lb. Crystal, 1s. 8d. to 1s. 10d. per lb.
- SODIUM SULPHIDE, PURE RECRYSTALLISED.—10d. to 1s. 1d. per lb.
- SODIUM SULPHITE, ANHYDROUS.—£27 10s. to £28 10s. per ton, according to quantity. Delivered U.K.
- SULPHONAL.—6s. 9d. to 7s. per lb.
- TARTAR EMETIC, B.P.—Crystal or powder, 2s. 1d. to 2s. 2d. per lb.
- THYMOL.—Puriss., 9s. 6d. to 9s. 9d. per lb., according to quantity. Firmer. Natural, 14s. 3d. per lb.

Perfumery Chemicals

- ACETOPHENONE.—7s. per lb.
- AUBEPINE (EX ANETHOL).—10s. per lb.
- AMYL ACETATE.—2s. 6d. per lb.
- AMYL BUTYRATE.—4s. 9d. per lb.
- AMYL SALICYLATE.—2s. 9d. per lb.
- ANETHOL (M.P. 21/22° C.).—5s. 3d. per lb.
- BENZYL ACETATE FROM CHLORINE-FREE BENZYL ALCOHOL.—2s. per lb.
- BENZYL ALCOHOL FREE FROM CHLORINE.—2s. per lb.
- BENZALDEHYDE FREE FROM CHLORINE.—2s. 6d. per lb.
- BENZYL BENZOATE.—2s. 6d. per lb.
- CINNAMIC ALDEHYDE NATURAL.—15s. 6d. per lb.
- COUMARIN.—9s. 9d. per lb.
- CITRONELLAL.—13s. 6d. per lb.
- CITRAL.—8s. 3d. per lb.
- ETHYL CINNAMATE.—6s. per lb.
- ETHYL PHTHALATE.—2s. 6d. per lb.
- EUGENOL.—10s. 6d. per lb.
- GERANIOL (PALMAROSA).—23s. per lb.
- GERANIOL.—6s. 6d. to 11s. per lb.
- HELIOTROPINE.—4s. 9d. per lb.
- ISO EUGENOL.—14s. 6d. per lb.
- LINALOL.—Ex Bois de Rose, 15s. per lb. Ex Shui Oil, 10s. 6d. per lb.
- LINALYL ACETATE.—Ex Shui Oil, 14s. 6d. per lb. Ex Bois de Rose, 18s. 6d. per lb.
- METHYL ANTHRANILATE.—8s. 6d. per lb.
- METHYL BENZOATE.—4s. per lb.
- MUSK KETONE.—35s. per lb.
- MUSK XYLOL.—7s. per lb.
- NEROLIN.—3s. 6d. per lb.
- PHENYL ETHYL ACETATE.—11s. per lb.
- PHENYL ETHYL ALCOHOL.—10s. 6d. per lb.
- RHODINOL.—38s. per lb.
- SAFROL.—1s. 6d. per lb.
- TERPINEOL.—1s. 6d. per lb.
- VANILLIN.—16s. 6d. per lb.

Essential Oils

- ALMOND OIL.—Foreign S.P.A., 10s. 6d. per lb.
- ANISE OIL.—2s. 9d. per lb.
- BERGAMOT OIL.—26s. per lb.
- BOURBON GERANIUM OIL.—21s. per lb.
- CAMPHOR OIL.—9d. per lb.
- CANANGA OIL, JAVA.—12s. 9d. per lb.
- CINNAMON OIL LEAF.—6s. 9d. per oz.
- CASSIA OIL, 80/85%.—7s. 9d. per lb.
- CITRONELLA OIL.—Java, 2s. 1d. per lb., c.i.f. U.K. port. Ceylon, pure, 2s. 2d. per lb.
- CLOVE OIL (PURE 90/92%).—6s. 6d. per lb.
- EUCALYPTUS OIL, AUSTRALIAN, B.P. 70/75%.—2s. 1d. per lb.
- LAVENDER OIL.—Mont Blanc, 48/50%, Esters, 16s. per lb.
- LEMON OIL.—12s. 6d. per lb.
- LEMONGRASS OIL.—4s. 3d. per lb.
- ORANGE OIL, SWEET.—35s. per lb.
- OTTO OF ROSE OIL.—Anatolian, 35s. per oz. Bulgarian, 55s. per oz.
- PALMA ROSA OIL.—14s. 6d. per lb.
- PEPPERMINT OIL.—Wayne County, 15s. per lb.; Japanese, 7s. per lb.
- PETITGRAIN.—7s. 3d. per lb. Sandalwood, Mysore, 26s. 6d. per lb., 90/95%, 16s. 6d. per lb.

London Chemical Market

The following notes on the London Chemical Market are specially supplied to THE CHEMICAL AGE by Messrs. R. W. Greeff & Co., Ltd., and Messrs. Chas. Page & Co., Ltd., and may be accepted as representing these firms' independent and impartial opinions.

London, June 28, 1928.

THERE has been practically no change in prices, which are steady, and a fair amount of business has been passing, especially for export.

General Chemicals

ACETONE is in good request, price firm and unchanged at £65 to £67 per ton, according to quantity.
ACETIC ACID.—Demand is good and prices unchanged.
ACID FORMIC is in good demand, price unchanged at £47 per ton for 85%.
ACID LACTIC.—Unchanged.
ACID OXALIC is in steady demand, price unchanged at £31 to £33 per ton.
ACID TARTARIC.—Demand is fair. Price unchanged at 1s. 4½d. to 1s. 5d. per lb.
AMMONIUM CHLORIDE.—Unchanged.
ALUMINA SULPHATE is still very short for spot and early delivery. Price firm at £6 to £6 10s. per ton for 17-18%.
ARSENIC.—Unchanged.
BARIUM CHLORIDE is still very short for early delivery and price is very firm at £9 per ton.
COPPER SULPHATE.—Unchanged.
CREAM OF TARTAR is in fair request at £104 per ton, less 2½% for 99/100%.
FORMALDEHYDE is in good demand at £39 10s. for 40% in casks.
LEAD ACETATE.—Demand is good at £42 10s. to £43 10s. for white, with brown at £1 per ton less.
LEAD NITRATE.—Unchanged.
LIME ACETATE.—Unchanged.
METHYL ACETONE is in steady demand at £56 to £58 per ton for 45%.

POTASSIUM CARBONATE AND CAUSTIC.—Unchanged.
POTASSIUM CHLORATE.—Unchanged at 3d. to 3½d. per lb.
POTASSIUM PERMANGANATE is firm and in good demand at 5½d. for B.P.
POTASSIUM PRUSSIAN is firm at £63 10s. to £65 10s., according to quantity.
SODIUM ACETATE is still in short supply at £22 per ton.
SODIUM PHOSPHATE.—Unchanged.
SODIUM PRUSSIAN is still in good demand and firm at 5d. per lb.
SODIUM SULPHIDE.—Unchanged.
TARTAR EMETIC.—Supplies are becoming short for early delivery. Price is maintained at 11½d. per lb.
ZINC SULPHATE.—Unchanged.

Coal Tar Products

THE market for coal tar products remains quiet, with little change to report in prices from last week.
MOTOR BENZOL is unchanged, at about 1s. 4d. per gallon, on rails.
SOLVENT NAPHTHA is quoted at 1s. 1d. to 1s. 2d. per gallon, on rails, at works.
HEAVY NAPHTHA is quoted at 1s. 1d. to 1s. 2d. per gallon, on rails, at works.
CREOSOTE OIL.—The price for spot deliveries is about 6½d. per gallon on rails in the North, and about 7d. per gallon in London. There is a tendency towards a further reduction for forward delivery.
CRESYLIC ACID remains weak, the 98/100% quality being quoted at about 2s. 6d. per gallon, f.o.b., and the dark quality, 95/97%, is quoted at about 1s. 10d. to 1s. 11d. per gallon.
NAPHTHALENES.—The 74/76 quality can be bought at £5 per ton, and the 76/78 quality at £6 to £6 10s. per ton.
PITCH.—There is nothing fresh to report. Prices remain unchanged at 60s. to 65s. per ton, f.o.b., main U.K. ports.

Latest Oil Prices

LONDON, JUNE 27.—LINSEED OIL steady but quiet. Spot, ex-mill, £29 10s.; June, £28 10s.; July-August, £28 15s.; September-December, £29 5s.; and January-April, £29 10s. per ton. RAPE OIL slow. Crude, extracted, £41 15s.; technical refined, £43 15s., naked, ex-wharf. COTTON OIL quiet. Egyptian crude, £35, refined common edible, £40; deodorised, £42 per ton, naked. TURPENTINE quiet and a further 3d. lower. American spot, 44s. 9d., and July-December, 45s. per cwt.

Nitrogen Products

Export.—The price for prompt shipment ranges from £9 2s. 6d. to £9 5s. f.o.b. U.K. port in single bags. The German Nitrogen Syndicate have not yet announced their price for the coming season. When this announcement has been made, it is expected that prices in various countries will come into line.

Home.—British producers have announced for the month of July they will continue in operation on the price of £10 13s. delivered, in 6-ton lots to farmers' nearest station. The usual additions of prices for smaller quantities remain in force.

Nitrate of Soda.—The nitrate market continues featureless, with nothing doing. Producers are holding firm with 16s. 4d. per metric quintal f.a.s. Chile. It is not expected that much business will be transacted until sulphate prices are announced.

South Wales By-Products

SOUTH WALES by-product activities remain featureless with the one exception of refined tars, for which there is a strong demand. Pitch values appear to have touched bottom, and the situation at the moment seems to be that buyers are waiting continental developments. There is an impression that German stocks are awaiting clearance, and there is not likely to be any break in the present situation until this hope materialises or is dissipated by events. Pitch prices realised for delivery in South Wales at present approximate 60s. to 65s. per ton. Refined tar, coke oven, has advanced slightly to from 8d. to 8½d. per gallon, delivered in barrels, and from 7½d. to 8d. delivered in tanks; gasworks tar remains at from 7½d. to 7¾d. per gallon. Crude tar, which has a small demand, continues

to change hands round about 50s. per ton f.o.r. Crude naphthalene has practically no call round about 80s. per ton f.o.r., while the same remark applies to whizzed at about 90s. per ton f.o.r. Heavy naphtha is unchanged at from 1s. to 1s. 1d. per gallon f.o.r., while creosote appears fixed at from 6½d. to 6¾d. per gallon f.o.r. maker's works. Patent fuel and coke exports continue to be slow and prices show a tendency to ease. Patent fuel, Cardiff, sells at from 21s. to 22s. per ton, while from 20s. to 20s. 6d. per ton prevails ex-ship at Swansea. Coke prices are unchanged, best foundry selling at from 32s. 6d. to 37s. per ton, furnace from 19s. to 21s. per ton, and other sorts from 25s. to 32s. 6d. per ton.

Sulphate of Ammonia Home Prices

NITRAM, LIMITED, Victoria Station House, London, S.W.1, announce that the price for neutral sulphate of ammonia, basis 20.6 per cent. nitrogen for home agricultural use, during the month of July will be £10 13s. per ton delivered carriage paid in 6-ton lots and upwards to buyer's nearest station, or ex works in 1-ton lots and upwards, all other terms and conditions as per their circulars 2/28N and 2a/28N.

Japanese Imports of Ammonium Sulphate

IMPORTS of sulphate of ammonia into Japan fell off somewhat in 1927 owing to the decreased purchasing powers of the farmers. The Japanese imports of this commodity for the last three years together with the principal countries of origin are shown (short tons) in the following table:

Country of Origin	1925	1926	1927
United States	58,086	75,593	44,814
United Kingdom	29,798	43,593	66,642
Germany	116,898	192,264	150,163
Other Countries	19,116	14,180	13,396
Total	223,898	325,630	275,015

The United States, Japan's principal source of supply in the years immediately following the World War, has fallen to third place, while Germany has supplied over 50 per cent. of the Japanese sulphate of ammonia imports during the past three years. The United Kingdom now occupies second place.

Scottish Chemical Market

The following notes on the Scottish Chemical Market are specially supplied to THE CHEMICAL AGE by Messrs. Charles Tennant and Co., Ltd., Glasgow, and may be accepted as representing the firm's independent and impartial opinion.

Glasgow, June 27, 1928.

DURING the past week business in the heavy chemical market has been rather quieter, and there are no changes of any importance to record.

Industrial Chemicals

ACETONE B.G.S.—£64 to £67 per ton, ex store, according to quantity.
 ACID ACETIC.—98/100% glacial, £56 to £67 per ton, according to quality and packing, c.i.f. U.K. ports; 80% pure, £37 10s. per ton, ex wharf; 80% technical, £37 10s. per ton, ex wharf.
 ACID BORIC.—Crystals, granulated or small flakes, £30 per ton, powder £32 per ton, packed in bags, carriage paid U.K. stations.
 ACID CARBOLIC, ICE CRYSTALS.—Quoted 6½d. per lb., delivered. In little request.
 ACID CITRIC, B.P.—Offered for spot delivery at 1s. 11½d. per lb., less 5%, ex store. Quoted 1s. 11d. per lb., less 5%, ex wharf, to come forward.
 ACID HYDROCHLORIC.—Usual steady demand. Arsenical quality, 4s. per carboy. Dearsenicated quality, 5s. 6d. per carboy, ex works, full wagon loads.
 ACID NITRIC, 80°.—Quality £24 10s. per ton, ex station, full truck loads.
 ACID OXALIC, 98/100%.—On offer from the Continent at 3½d. per lb., ex wharf. Spot material quoted 3½d. per lb., ex store. In better demand.
 ACID SULPHURIC.—£2 15s. per ton, ex works, for 144° quality; £5 15s. per ton for 168° quality. Dearsenicated quality 20s. per ton extra.
 ACID TARTARIC, B.P. CRYSTALS.—Now quoted 1s. 4½d. per lb., less 5%, ex wharf.
 ALUMINA SULPHATE, 17/18%, IRON FREE.—Quoted £5 15s. per ton, c.i.f. U.K. ports, prompt shipment. Spot material available at about £5 15s. per ton, ex store.
 ALUM, LUMP POTASH.—Spot material available at about £9 per ton, ex store. Crystal meal quoted £8 10s. per ton, ex store. Lump quality on offer from the Continent at £8 5s. per ton, c.i.f. U.K. ports.
 AMMONIA, ANHYDROUS.—Quoted 9d. per lb., carriage paid, containers extra and returnable.
 AMMONIA CARBONATE.—Lump, £37 per ton; powdered, £39 per ton, packed in 5-cwt. casks, delivered or f.o.b. U.K. ports.
 AMMONIA LIQUID, 88°.—Unchanged at about 2½d. to 3d. per lb., delivered, according to quantity.
 AMMONIA MURIATE.—Grey galvanisers' crystals of British manufacture, quoted £21 to £22 per ton, ex station. Continental, about £19 per ton, c.i.f. U.K. ports. Fine white crystals of Continental manufacture quoted £16 15s. per ton, c.i.f. U.K. ports.
 ARSENIC, WHITE POWDERED.—On offer for prompt despatch from mines at £19 per ton, ex wharf. Spot material quoted £20 per ton, ex store.
 BARIUM CARBONATE, 98/100%.—English material on offer at £7 5s. per ton, ex store. Continental quoted £7 per ton, c.i.f. U.K. ports.
 BARIUM CHLORIDE, 98/100%.—Large white crystals quoted £6 15s. per ton, c.i.f. U.K. ports.
 BLEACHING POWDER.—British manufacturers' contract price to consumers, £6 12s. 6d. per ton, delivered, minimum 4-ton lots. Continental on offer at £6 10s. per ton, ex wharf.
 CALCIUM CHLORIDE.—British manufacturers' price, £4 5s. to £4 15s. per ton, according to quantity and point of delivery. Continental material on offer at £3 12s. 6d. per ton, c.i.f. U.K. ports.
 COPPERAS, GREEN.—Unchanged at about £3 10s. per ton, f.o.r. works, or £4 12s. 6d. per ton, f.o.b. U.K. ports for export.
 COPPER SULPHATE.—Rather firmer now. Quoted £25 per ton, c.i.f. U.K. ports, but some spot parcels of small crystals available at somewhat less.
 FORMALDEHYDE, 40%.—Quoted £35 10s. per ton, c.i.f. U.K. ports. Spot material now on offer at £38 per ton, ex store.
 GLAUBER SALTS.—English material unchanged at £4 per ton, ex store or station. Continental quoted £2 15s. per ton, c.i.f. U.K. ports.
 LEAD, RED.—Imported material on offer at £31 per ton, ex store.
 LEAD, WHITE.—£35 to £37 per ton, c.i.f. U.K. ports.
 LEAD ACETATE.—White crystals quoted £39 15s. per ton, c.i.f. U.K. ports; brown, £32 10s. per ton, c.i.f. U.K. ports. Spot material on offer at £42 15s. per ton, ex store, spot delivery.
 MAGNESITE, GROUND CALCINED.—Quoted £8 10s. per ton, ex store, in moderate demand.
 METHYLATED SPIRIT.—Industrial quality 64° O.P. quoted 1s. 7d. per gallon, less 2½%, delivered.
 POTASSIUM BICHRIMATE.—4½d. per lb. delivered, minimum 4-ton lots. Under 4-ton lots ½d. per lb. extra.

POTASSIUM CARBONATE, 96/98%.—Quoted £25 10s. per ton, ex wharf, prompt shipment from the Continent. Spot material available at £26 10s. per ton, ex store.
 POTASSIUM CHLORATE.—99½/100% powder quoted £23 10s. per ton, c.i.f. U.K. ports. Crystals, 30s. per ton extra. B.P. quality, crystals or powder, offered at £32 per ton, c.i.f. U.K. ports.
 POTASSIUM NITRATE.—Refined granulated quality quoted £19 2s. 6d. per ton, c.i.f. U.K. ports. Spot material on offer at about £20 10s. per ton, ex store.
 POTASSIUM PERMANGANATE, B.P. CRYSTALS.—Quoted 5½d. per lb. ex wharf.
 POTASSIUM PRUSSIAN (YELLOW).—Unchanged at about 6½d. per lb. ex store, spot delivery. Offered from the Continent at 6½d. per lb.
 SODA CAUSTIC.—Powdered, 98/99%, £17 17s. 6d. per ton; solid, 76/77%, £14 10s. per ton; and 70/72%, £13 12s. 6d. per ton, minimum 4-ton lots, carriage paid on contract. Spot material, 10s. per ton extra.
 SODIUM ACETATE.—Spot material on offer at about £22 per ton, ex store.
 SODIUM BICARBONATE.—Refined recrystallised, £10 10s. per ton, ex quay or station. M.W. quality, 30s. per ton less.
 SODIUM BICHRIMATE.—Quoted 3d. per lb. delivered buyers' works, minimum 4-ton lots. Under 4 and over 2-ton lots, 1/10d. per lb. Under 2-ton lots, 3½d. per lb.
 SODIUM CARBONATE (SODA CRYSTALS).—£5 to £5 5s. per ton, ex quay or station. Powdered or pea quality, 27s. 6d. per ton extra. Light soda ash, £7 3s. 9d. per ton, ex quay, minimum 4-ton lots with various reductions for contracts.
 SODIUM HYPOSULPHITE.—Large crystals of English manufacture quoted £8 17s. 6d. per ton, ex station, minimum 4-ton lots. Pea crystals on offer at £14 15s. per ton, ex station, minimum 4-ton lots.
 SODIUM NITRATE.—Quoted £11 per ton, ex store.
 SODIUM NITRITE, 100%.—Quoted £19 10s. per ton, ex store.
 SODIUM PRUSSIAN.—In moderate demand. Spot material now quoted 4½d. per lb., ex store.
 SODIUM SULPHATE (SALTCAKE).—Prices, 50s. per ton, ex works, for underground quality, 52s. 6d. per ton, delivered. Ground quality, 2s. 6d. per ton extra.
 SODIUM SULPHIDE.—Prices for home consumption: Solid, 60/62%, £9 per ton; broken, 60/62%, £10 per ton; crystals, 30/32%, £7 2s. 6d. per ton, delivered. Buyers works, on contract, minimum 4-ton lots. Special prices for some consumers. Spot material, 5s. per ton extra.
 SULPHUR.—Flowers, £12 per ton; roll, £10 15s. per ton; rock, £10 12s. 6d. per ton; ground American, £9 5s. per ton; ex store. Prices nominal.
 ZINC CHLORIDE.—British material, 98/100% quoted £24 15s. per ton, f.o.b. U.K. ports; 98/100% solid on offer from the Continent at about £21 15s. per ton, c.i.f. U.K. ports. Powdered 20s. per ton extra.
 ZINC SULPHATE.—Quoted £11 per ton, ex wharf, prompt shipment from the Continent.

NOTE.—The above prices are for bulk business and are not to be taken as applicable to small parcels.

De Vecchis Process in Russia

MENTION was recently made in this journal to the disposal of the patent rights of the De Vecchis beet sugar process to a French group which will in future control the development of the process in France, Belgium and Luxemburg. This group is now engaged in developing a scheme for the establishment of one or more factories on a considerable scale. George Scott and Son (London), Ltd., also announce that they have recently received an order for a large dryer of the "Scott" patent type for Arcos, Ltd. This dryer is connected with the establishment of a plant to operate the De Vecchis process in Russia. The plant in question will be in operation during the forthcoming beet sugar campaign in Russia.

J. H. Sankey and Son

THE directors of J. H. Sankey and Son, Ltd. announce that there is no truth in the rumours that they have sold any part of their interests to another company, or that they have entered into any "working arrangements." J. H. Sankey and Son, Ltd., of Canning Town, are still a private limited company owned and managed by members of the Sankey family. This announcement, will, it is hoped, avoid a continuance of the confusion which has arisen through the rumours referred to.



The strength and reliability of the renowned Liverpool Cart-horses are equalled, if not surpassed, by Brough's Patent Bevel-edged Drums — another famous Liverpool product.

GREAT STRENGTH AND RELIABILITY

Brough's Patent Indestructible Drums and Kegs embody the practical experience of 25 years. They are made by a combination of Oxy-Acetylene and Electric Welding. No Lead, Tin, Solder, or Rivets are used, and all the principal features are patented.

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Company News

BULMER RAYON Co.—The accounts for the past year show a loss of £18,081, and the adverse balance brought forward was increased to £50,471.

B. LAPORTE, LTD.—We are informed that the half-yearly dividend to June 30, on both classes of preference shares (6 per cent. and 7½ per cent.) will be paid to-day, June 30.

DISTILLERS COMPANY.—A final dividend of 2s. 6d. per share less tax, is announced, making 20 per cent. for the year. £400,000 is placed to reserve, £5,000 to fire insurance, and £212,532 is carried forward.

CHESHIRE UNITED SALT.—Circular states the profit for the three months ended May 31, 1928, amounted to £1,901, subject to allowances for interest charges and London office expenses. The profit for May constituted a record, amounting to £995, or at rate of nearly £12,000 per annum.

ARIZONA COPPER Co.—It is stated that the Phelps Dodge Corporation have declared a dividend of 2 per cent., payable on July 2, for the quarter ending June 30. When the Arizona Co. formed an arrangement with the Phelps Dodge Corporation, the Phelps Dodge dividend for several years was at the rate of 4 per cent. per annum. Two years ago it was increased to a rate of 6 per cent. per annum. The dividend now declared represents 8 per cent. per annum.

REEVES AND SONS.—The report for the year ended April 30 last states that in view of the large additions to the plant, the directors have this year placed £5,500 to provision for depreciation. An interim dividend of 2½ per cent. was paid on the ordinary shares on January 20 last. There is a balance of profit of £19,178. The directors recommend a final dividend of 7½ per cent., making 10 per cent. for year, on the ordinary shares, and that £8,139 be carried forward.

BRITISH GLUES AND CHEMICALS.—The report for the eleven months ended April 30, 1928, states that the net profit, after due allowance has been made for depreciation, bad and doubtful debts, and directors' fees, amounted to £51,286. It is proposed to pay on July 31 the fixed cumulative dividend on the 8 per cent. cumulative preference shares for the half-year ended April 30, 1928, less income-tax, place to reserve for taxation £5,000, and to carry forward £29,486. Since the end of the period for which the accounts are submitted, the scheme of capital reorganisation approved by shareholders has been sanctioned by the Court, and accordingly future accounts will be presented on the reduced capital basis.

SHIP CANAL PORTLAND CEMENT MANUFACTURERS.—For the year ended March 31 last, the profit figure constitutes a record in the history of the company, and the net profit is stated to be more than double that of last year. After paying all expenses, maintenance and repairs, the profit was £227,332, as compared with last year's figure of £82,331. After charging directors' and auditors' fees, etc., amounting to £3,274, debenture and other interest, trustees' fees, etc., amounting to £45,571, and providing £40,000 for taxation, the net profit for the year (as compared with last year's figure of £60,398) amounts to £138,708, to which has been added £11,204 brought in, making £149,912. The directors recommend the transfer to reserve for depreciation of properties, plant and investments (as against £40,000 last year), £50,000 and the payment of a dividend of 10 per cent., less tax, on 2,500,000 fully-paid ordinary shares, leaving to carry forward £38,662.

Chemical Trade Inquiries

The following inquiries, abstracted from the "Board of Trade Journal," have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1. British firms may obtain the names and addresses of the inquirers by applying to the Department (quoting the reference number and country), except where otherwise stated.

SULPHATE OF COPPER AND CHEMICAL MANURES.—An agent in Algiers desires to obtain the representation of British manufacturers. (Reference No. 598.)

MACHINERY FOR THE DEHYDRATION OF GLAUBER SALT.—The Officer-in-Charge of the Office of H.M. Trade Commissioner at Toronto reports that a local firm is in the market for machinery for the dehydration of Glauber salt, with a capacity of 50 tons a day. (Reference B.X. 4516.)

Manchester Chemical Market

(FROM OUR OWN CORRESPONDENT.)

Manchester, June 28, 1928.

HAVING regard to the state of the cotton trade in this part of the country and to the fact that the holiday season in the industrial districts starts this week end business in chemicals on this market is maintained at a fair level. This applies more especially to contract commitments, for buying interest in the spot market this week has been only on moderate lines with home users, for the most part, rigidly restricting the size of their orders, while inquiry on export account has also been slow.

Heavy Chemicals

Prices of sulphide of sodium have still an easy tendency and little new business of any importance has been reported; 60-65 per cent. concentrated solid material is selling at from £9 10s. to £10 per ton, with commercial on offer at round £7 15s. There has been no change in the position of bicarbonate of soda, a fair trade going through on the basis of £10 10s. per ton. Alkali also keeps firm and meets with a moderate demand, with contract offers at £6 2s. 6d. per ton. Chlorate of soda this week has been on the quiet side but values are pretty much as they were at last report, offers being in the neighbourhood of 2½d. per lb. Nitrite of soda is well held at from £19 10s. to £19 15s. per ton and fair sales have been made. A quietly steady business is being done in bleaching powder and at round £7 per ton quotations in this section are steady. Caustic soda keeps firm at from £13 7s. 6d. to £15 7s. 6d. per ton, according to quality, and contract deliveries of this material continue on a fairly satisfactory scale. Saltcake is on the quiet side and the tendency is easy at about £2 12s. 6d. per ton. There is a certain amount of inquiry about for bichromate of soda and offers remain at round 3d. per lb. Phosphate of soda is currently quoted at £12 5s. per ton but only a moderate business in this material is being put through. Hypo-sulphite of soda is in quiet demand with values about unchanged on the week at £9 5s. per ton for the commercial grade and £15 10s. for the photographic. Prussiate of soda has been selling this week in moderate quantities at from 4½d. to 5d. per lb.

Generally speaking, price movements in the case of the potash products has been of minor importance and the tone is fairly steady. Caustic potash meets with a fair amount of inquiry and values are maintained at from £33 5s. per ton for prompt delivery of one to five-ton lots. The demand for carbonate of potash has been on quiet lines but offers are still at about £25 per ton. Buying interest in permanganate of potash is still rather slow, with commercial quality quoted at 4½d. per lb. and B.P. at about 5d. There is some inquiry about both for chlorate and bichromate of potash, offers of which are at round 3d. and 4d. per lb., respectively. Yellow prussiate of potash is selling in moderate quantities and prices keep steady at from 6½d. to 7½d. per lb.

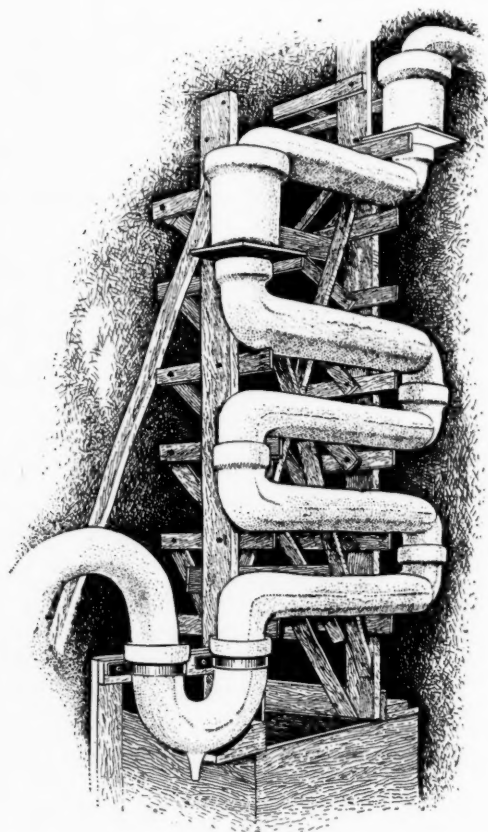
The demand for sulphate of copper seems to have slackened off somewhat and lower prices are being mentioned in this section, about the top figure on export account being round £26 10s. per ton, f.o.b. Although business in arsenic is still of limited extent values are about maintained at £17 per ton, at the mines, for white powdered, Cornish makes. A quiet trade is passing in the case of acetate of lime but at £9 10s. per ton for brown and £16 5s. for grey values show little change on the week. Relatively little business is being done just now in the lead products and prices seem to be developing a certain amount of easiness again; acetate is on offer at £39 5s. per ton for brown and £40 for white, with nitrate still quoted at round £37 per ton.

Acids and Tar Products

Oxalic acid is fairly steady at from 3½d. to 3¾d. per lb. but inquiry for this material during the past few days has been quiet. A moderate business is reported in acetic acid, with the commercial 80 per cent. quality quoted at £36 10s. per ton and the glacial at round £66. Tartaric acid is slow and values are on the easy side at 1s. 4½d. per lb., with citric acid in much the same position at down to 1s. 10½d.

The demand for creosote oil is comparatively quiet but no further change in prices has been reported, these being at round 6½d. per gallon, at works. Pitch continues inactive and quotations are nominal at from £2 17s. 6d. to £3 per ton, f.o.b.

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ABC Code, 5th & 6th Editions, & Bentley's used

WHERE TO BUY
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AERIAL ROPEWAYS.

British Ropeway Engineering Co., 7, Mincing Lane, London.

AUCTIONEERS.

Hancock & Sons, Sydney Place, St. Austell.

BAGS AND LINERS (COTTON).

Feltham, W. H., & Son, Tower Bridge Road, London, S.E.1.

BANKS.

Barclays Bank, Limited.

CANVAS GOODS.

The N.F. Waterproofing Co., Ltd., Woodside Lane, N. Finchley, N.12.

CHINA CLAY AND CHINA STONE.

Best, Jas., & Sons, Longport, Stoke-on-Trent.
Bloomdale China Clay Co., Ltd., 80, Bishopsgate, E.C.
Burthy China Clay Co., Y.M.C.A. Buildings, St. Austell.
Carbis China Clay & Brick Co., Y.M.C.A. Buildings, St. Austell.
Catalpo, Ltd., London.
Consolidated Mines of Cornwall, 32, Seething Lane, E.C.
Dartmoor China Clay Co., Ltd., 11, Queen Victoria St., E.C.4.
Dyer, Samuel J., Market Hill, St. Austell.
English China Clays, Ltd., St. Austell.
Fox, Roy & Co., Plymouth.
Grose & Stocker, Stoke-on-Trent.
Lovering, J., & Co., St. Austell.
New Halwyn China Clay Co., Y.M.C.A. Buildings, St. Austell.
Newquay China Clay Co., Ltd., Newquay, Cornwall.
North Goonbarrow China Clay, Ltd., 3, Victoria Place, St. Austell.
Parkyn & Peters.
Pochin, H. D., & Co., Manchester.
Somerset Oxide and Ochre Co.
Tehidy Minerals, Ltd., 3, St. Petroc House, Bodmin, Cornwall.
Trethowal China Clay Co., Y.M.C.A. Buildings, St. Austell.
United China Clay Co., Ltd., 80, Bishopsgate, E.C.2.
Varcoes China Clays, Ltd., 107, Market Street, Manchester.
West Carclaze China Clay Co., St. Austell.
Wood, T.A.V., Ltd., Grant's Walk, St. Austell.

COALS.

Cornish Mines Supplies Co., Ltd., St. Austell.
Dunkerton Collieries, Dunkerton, near Bath.
H. Rees Jones & Co., Cardiff.
Stockwood, Rees & Co., Ltd.
Welsh Navigation Steam Coal Co., Ltd., Cardiff.

COLLIERIES.

Dunkerton Collieries, Ltd., Dunkerton, near Bath.
Rees Jones & Co., Ltd., Cardiff.

COLOURS AND CHEMICALS.

Brown, R. B., & Co., 45, Finsbury Square, E.C.
Podmore, W. & A. J., Caledonian Mills, Shelton, Stoke-on-Trent.

ELECTRICAL ENGINEERS.

Harry H. Gardam & Co., Ltd., Staines.

ENGINEERS.

Holman Bros., Camborne.
Paulls (Engineers), Ltd., Fowey.
Sidney Smith & Blyth, Ltd., Garratt Lane, Wandsworth, S.W.18.

FILTERPRESS.

Premier Filterpress Co., Finsbury Pavement House, E.C.

GAS ENGINES.

Crossley Bros., Ltd., Manchester.

IRONMONGERS.

Cornish Mines Supplies Co., Ltd., St. Austell.
Stocker, F. E., Ltd., St. Austell.
Hawke & Son, St. Austell.

LAND & MINE SURVEYORS.

Trythall & Champion, Camborne.

LUBRICANTS.

Cornish Mines Supply Co., Ltd., St. Austell.
Reliance Lubricating Oil Co., Ltd., 19-20, Water Lane, E.C.
Willcox, W. H., & Co., Ltd., 32-38, Southwark Street, London, S.E.1.

MINING ENGINEERS.

Rich, Wm., & Sons, Redruth.

MINING MACHINERY.

Alluvials Mining Machinery Co., 2, Broad Street Place, E.C.
Cornish Mines Supplies Co., Ltd., St. Austell.
Hadfields, Ltd., East Hecla Works, Tinsley, Sheffield.
Rich, Wm., & Sons, Redruth, Cornwall.

MINING SUPPLIES.

Cornish Mines Supply Co., Ltd., St. Austell.
Hadfields, Ltd., East Hecla Works, Tinsley, Sheffield.
Holman Bros., Camborne.
Rich, Wm., & Sons, Redruth, Cornwall.

MOTOR TRANSPORT.

Mid-Cornwall Transport Co., Ltd. (1922), Bodmin Road, St. Austell.

PIPES.

British Mannesmann Tube Co., Ltd., Salisbury House, London Wall, E.C.2.
Ryland, A., Cradley Heath, Staffs.

PUMPS.

Alluvials Mining Machinery Co., 2, Broad Street Place, E.C.
Cornish Mines Supplies Co., Ltd., St. Austell.
Willcox, W. H., & Co., Ltd., 32-38, Southwark Street, London, S.E.1.

QUARRYING AND MINING REQUISITES.

Cornish Mines Supplies Co., Ltd., St. Austell.
Hadfields, Ltd., East Hecla Works, Tinsley, Sheffield.
Rich, Wm., & Sons, Redruth, Cornwall.
Warden, F. H., Ltd., Birmingham.

RAILS (Bridge, Flange, Double or Bullhead).

Bute Works Supply Co., Ltd., 53, Cymric Buildings, Cardiff.

RAILWAY WAGONS.

Bute Works Supply Co., Ltd., 53, Cymric Buildings, Cardiff.
Roberts, Charles, & Co., Ltd., Horbury Junction, nr. Wakefield.

ROPES.

Cornish Mines Supplies Co., Ltd., St. Austell.

SHIPBROKERS.

Blake, G. A., 11, High Cross Street, St. Austell.
Ludlow & Sons, Penzance.
Simpson, Spence & Young, London.
Toyne, Carter & Co., Fowey.

SACKS & BAGS.

Andrew Weir & Co., 21, Parliament Street, Liverpool.
Boag, Thos., & Co., Ltd., Greenock.
Cornish Mines Supplies Co., Ltd., St. Austell.
Dovener, J. H., & Co., Union Street, Liverpool.
North Mills Co., Ltd., Little Peter Street, Manchester.
The N.F. Waterproofing Co., Ltd., Woodside Lane, N. Finchley, N.12.

TIMBER IMPORTERS.

Cornish Mines Supplies Co., Ltd., St. Austell.
Fox, Elliott & Co., Plymouth.
T. Warne, St. Austell.

WATERPROOFING.

The N.F. Waterproofing Co., Ltd., Woodside Lane, N. Finchley, N.12.

WIRE ROPES.

Hood Haggie & Son, Ltd., Newcastle-on-Tyne.
Stephens, John, & Son, Ltd., Falmouth, England.

The China Clay Trade Review

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China Clay Industry's Record Deliveries

Following the big jump in China Clay deliveries in November, we predicted that the total figures of the year would approach, if not exceed, the total of the biggest "boom year" the industry has experienced, namely, 1912. The December figures of deliveries have more than fulfilled this prediction, for the "all-in" total for the year was 997,269 tons, nearer to the million mark than the industry has ever previously been. The details are set out as usual on the last page of this issue in comparison with the previous year, but the chief interest centres in the fact that last year was the biggest year the industry has ever experienced in point of tonnage as well as value.

China Clay Total

It may be said that the total is swollen by the inclusion of deliveries of China Stone and Ball Clay. But if the figures are taken separately they still show a big balance in favour of 1927. China Clay alone delivered in 1912 amounted to 890,611 tons against 920,074 tons delivered in 1927, but against the 73,284 tons of China Stone delivered in 1912, 54,551 tons were delivered in 1927. Ball Clay deliveries, which are now recorded but were not tabulated in 1912, though they, of course, swell the "all-in" total by 22,644 tons, do not effect the separate figures relating to China Clay.

The Reason

Of course, it is known what has given such a remarkable spurt to the China Clay deliveries during the last two or three months of the year, the decision to set up a new organisation which has been functioning as from January 1 causing buyers to expedite the execution of orders under contract as well as large additional quantities. It is not a good thing for the industry to be subject to abnormal demand, as was seen during the closing months of 1927, because of the reaction which inevitably follows, dislocating the employment market and production work. It is hoped that the reaction will not be so acute as has been suggested in some quarters, because many of the clay works have made big inroads into their stocks which must be replenished, and there is, of course, the necessity for development work which many firms have suspended on economic grounds, and which must now be undertaken.

Export Trade

A welcome feature of the trade in 1927 has been the gradual improvement in overseas markets, not only in America, but on the Continent. The record of exports for the eleven months to the end of November showed that the tonnage reached a total of 604,767 tons, value £1,239,411. In that period the U.S.A. imported 257,842 tons. The country importing the biggest quantity on the Continent was Belgium, which accounted for 56,308 tons. Except for quantities to countries which formerly formed part of Russia and are now included under the heading of Scandinavian countries, Russia's imports, which before the war amounted to 45,000 tons per annum, do not figure in the export list. Germany, while still a very long way behind her pre-war quantity of 90,000 tons per annum, is gradually creeping up in the export list, having this year so far with 30,662 tons reached her highest total since the war.

The tonnages taken by the other chief China Clay importing countries were: Scandinavian countries (including countries which formerly formed part of Northern Russia) 64,528 tons; Netherlands, 44,782 tons; India, 29,846 tons; France, 25,634 tons; Italy, 20,841 tons; Spain, 15,418 tons. Of the total of 853,652 tons of China Clay delivered for the eleven months for the end of November, it is interesting to note that while the export markets accounted for 604,767 tons, 227,885 tons were absorbed by the home markets. During the same period, 81,627 tons of China Stone and 21,647 tons of Ball Clay were also dealt with, but as the separate export records relating to these are not available, it is not possible to show the quantity absorbed by home and overseas markets. Probably the bulk of China Stone was absorbed at home.

1928

With the industry embarking upon 1928 under the auspices of an organisation which it is hoped will re-establish the industry economically, it enters upon the New Year with confidence. A consequence of the busy time the industry has had during the closing months of 1927 will be a slackening of employment on the production side for a month or two. Apart from this, there is, in the China Clay quarries, the necessity for a good deal of improvement being undertaken, which has been postponed previously owing to the stringent conditions under which the industry has been operating.

The continued briskness of shipping into January is accounted for by the fact that the new organisation gave buyers the privilege of taking additional supplies at 1927 prices into ships that were stemmed on December 31. The consequence was that superhuman efforts were made by buyers and brokers to get as many ships within this limit as possible, and they succeeded to such an extent that 25 vessels, some of them very large ones, were stemmed at Fowey, 4 at Par, and 8 at Charlestown. This means that all these vessels are taking in cargoes at 1927 prices. When they have been satisfied, there is likely to be a big slump in shipments and a postponement of the benefit producers hoped to derive from 1928 prices.

It cannot be denied that buyers have taken full advantage of the concession that was made to them, but it was never anticipated that the rush would be so overwhelming as it has been. It has brought a rich harvest to Fowey, where big gangs of jettymen and others associated with shipping have been employed full time and earning big money.

The December Trade Returns

The Board of Trade returns for December indicate that exports of China Clay (including Cornish or China Stone) during the month ending December 31, 1927, amounted to 57,059 tons, valued at £121,333, as compared with 50,244 tons (£105,110) in 1926, and 62,356 tons (£122,579) in 1925. For the year 1927, exports amounted to 655,836 tons (£1,360,744), as compared with 651,990 tons (£1,351,414) in 1926 and 652,576 tons (£1,350,760) in 1925. Adding fireclay and all other sorts, exports of all kinds of clay in 1927 had a value of £1,626,602, as compared with £1,629,898 and £1,661,357 in 1926 and 1925 respectively.

Research on Clay Products in the United States

An Account of Progress in 1926-27

The following account of American research on clay, written by A. V. Bleining, of the Homer Laughlin China Co., is taken from the "Annual Survey of American Chemistry," Vol. II, July, 1926—July, 1927 (published by the Chemical Catalog Co.)

THE technology of the clay products offers a peculiarly complex field, dealing as it does with the manipulation of raw materials, which, owing to the low permissible cost factor, must be used largely as nature supplies them, and with processes which are guided by the empirical experience of generations. This involved situation, combined with the complex structure and the unlimited variation of the clays and other silicates, has rendered the scientific attack of the industrial problems very difficult. It is not surprising, therefore, that many of the technical studies, in the endeavour to arrive at useful results as quickly as possible, have been largely empirical. It is only within the last few years that some headway has been made in reducing the variables involved to a reasonable number, and in studying fairly well defined systems under controlled conditions.

The application of the petrographic microscope and of the X-ray spectrum has been of considerable assistance in the study of the silicates of alumina, in both the hydrous and the anhydrous state. In dealing with the clays, some aid has been received from the results of colloid chemistry, but for tangible results we are still compelled to resort to our own devices. The more accurate fixation of the physical characteristics, especially of the thermal expansion and the mechanical properties, of our constituent materials has probably assisted as much as anything in extending our knowledge of ceramics.

Clays in the Hydrous State

The properties of clay suspensions are affected by the pH value of the dispersing liquid. Measurements of this constant have been made by Randolph and Donnenwirth (*J. Am. Ceram. Soc.*, vol. 9, 541 (1926)) but a really satisfactory correlation between the hydrogen ion concentration and such properties as the fluidity of the suspension is still lacking. In practical work the density of the suspension and its fluidity are up to the present time the best criteria for works control.

Determinations of the particle sizes of clays by means of the ultramicroscopic motion picture have been made by France (*J. Am. Ceram. Soc.*, vol. 9, 67 (1926)) at Ohio State University.

In the filterpressing of clay bodies the use of the triple and the diaphragm pumps is on the increase. The application of continuous filterpressing has made a good start. Spurrier (*J. Am. Ceram. Soc.*, vol. 9, 535 (1926)) considers the presence of included air in plastic clay to be detrimental to its working quality and proposes to subject the material to evacuation followed by a sudden breaking of the vacuum. Galpin (*J. Am. Ceram. Soc.*, vol. 9, 587 (1926)) has measured the volume of air occluded in clay and finds it to be from 10 to 55 per cent. of the original clay volume.

Progress is being made in exhausting the included air from clay suspensions, a procedure which is said to be of considerable benefit. Lapp reports the installation of a vacuum treatment for this purpose. Equipment for the exhaustion of air from clay in the plastic state and attached to the pugging machine has been worked out.

The definition and measurement of the plasticity of clays, as proposed by Bingham (*J. Phys. Chem.*, vol. 29, 1201 (1925)) are being given increased attention. In this connection it might be said that the plastometer designed by Green and Haslam (*Ind. Eng. Chem.*, vol. 17, 726 (1925)) could be adapted to the study of the plastic flow of fine grained clays. At the present time the Bureau of Standards is making a study of the work required to force clays through large orifices at different speeds.

For some time the design of more quickly operating apparatus for the determination of the volumes of clay specimens, required in the measurement of drying and firing shrinkages, has occupied several workers. Westman (*J. Am. Ceram. Soc.*, vol. 9, 311 (1926)) has discussed several types of apparatus for this purpose and has suggested the use of a mercury balance. MacGee (*J. Am. Ceram. Soc.*, vol. 9, 814 (1926)) has offered a discussion of various types of gas expansion porosimeters for the same kind of measurement.

Clays in the Anhydrous State

While a number of European workers have dealt with the reactions taking place in clays at lower temperatures, during the dehydration period, and at about 1,000° C., American investigators have concentrated upon the structural changes taking place at the higher temperatures. Navias has used the X-ray method to determine the amount of mullite, $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$, formed in fired clays and clay-feldspar mixtures, reporting from 33-50 per cent. mullite for the ball clays and 50 for the kaolins.

A very complete study of the differences between sillimanite, $\text{Al}_2\text{O}_3 \cdot \text{SiO}_2$, and mullite as indicated by the Laue and the powder X-ray spectographs has been made by Wyckoff, Greig and Bowen, of the Geophysical Laboratory, who brought out the fact that there are slight but probably real differences between these two crystalline silicates. Previous work by Norton on the X-ray spectra of mullite and sillimanite yielded the same result, and Navias and Davey noted a slight dissimilarity. Some European investigators have not yet fully accepted mullite as the definite decomposition product of clay substance but the fact remains that the evidence obtained so far is in favour of the American results.

It is of interest to note that recent work by Hirsch (*Trans. Ger. Ceram. Soc.*, vol. 7, 49 (1926)) on the function of silica in ceramic bodies when introduced as crystalline quartz, ground sand and true flint confirms the findings of the Bureau of Standards that Quartz promotes translucency while true flint yields bodies of higher mechanical strength. The work of Hirsch, however, is the most complete contribution on the subject.

An interesting study has been made of the microstructure of earthenware bodies by Insley who proved the existence of mullite in low fire bodies of this type.

Specific Heat of Clays

Determinations of the specific heat of clays have been made by MacGee and the heat absorbed computed from the interval values for different temperatures. The clays in undergoing an endothermic reaction at 575° C. absorb from 60 to 130 calories per gram of dried substance, while at 960° C. there is an evolution of heat amounting to 25 calories per gram. About 510 calories are required to heat a fire brick body from 25° to 1,200° C., the specific heat over this interval being 0.43. Ground quartz and feldspar absorb 290 calories per gram in being heated from 0° to 1,050° C., their specific heats being approximately 0.28. The method employed by MacGee has been criticised by Cohn. Earlier results on the heat absorption of clays by Navias are perhaps still the best existing.

Thermal Conductivity

The thermal conductivity of refractories was determined by Norton by means of a new type of apparatus. Taking the conductivities obtained between his extreme temperatures, 200°-1,400° C. values were found from 0.0024 to 0.0042 for fire brick, 0.0047 to 0.0070 for kaolin, 0.0028 to 0.0054 for silica brick, 0.040 for SiC, and 0.0062 to 0.0105 for fused alumina.

Thermal Expansion

A series of measurements of the thermal expansion of refractories was made by Norton. A valuable contribution to the subject was made by Shearer and Wyckoff, who determined the thermal expansion of clays, bodies and glazes and showed clearly the necessity of taking into account this important function in fitting glazes to ceramic mixtures. These workers used the interferometer designed for this purpose at the Bureau of Standards and described by Merritt. The same instrument was employed by Merritt and Peters in measuring the thermal expansion of earthenware bodies and glazes. The interferometer permits of the use of flakes of glaze lifted from the fired ware and thus makes it possible to make measurements upon the glaze as it actually is. The accurate temperature control likewise is of great value.

(To be concluded.)

China Clay: Then and Now

A 50 Years Retrospect and a Note on a Modern Hustle

WITH a new year and the increase in output marked by the year 1927, it is useful to look back to note the tremendous progress made in China Clay production since Captain David Cook wrote and published his book *A Treatise on China Clay* in 1880, writes a correspondent.

Shipping Facilities

In 1876 the total output of China Clay was given as 105,275 tons; in 1926 as 8,900,000 tons. In 1887 the quantity of clay shipped at the little port of Charlestown was given as 59,570 tons and the Fowey shipment as 132,492 tons. All the clay to Charlestown at that time would be road borne by horses and waggons and a large part of it would be brought a distance of 8 to 10 miles. It will be seen, therefore, that for haulage purposes a large number of horses were employed in the industry. A great change has taken place. With the coming of the railway through the areas the tendency has been wherever possible to place the drying kilns alongside the rail for direct loading into railway trucks and dispatch to port or by inland long distance rail to the customer. Even where road haulage has to be done, motor lorries have come into considerable use because of their being quicker on the road and able to carry larger quantities.

To deal with the greatly increased tonnage tremendous increase in jetties and up-to-date loading equipment has been made at Fowey by the Great Western Railway, and in recent years it has been stated that something like £300,000 has been spent in providing loading facilities, the tonnage loaded in Fowey in anything like a normal year being approximately 800,000.

Production Methods

It must not be assumed, however, that because the quantity of China Clay produced 50 years ago was, say, 100,000 tons, and has now risen to about 1,000,000, that there has not been, and is not at present, any competition to meet, or that cost of production is an entirely unimportant matter. Indeed, one of the most important features in China Clay working to-day, in order to maintain the present markets against the domestic clays produced in other countries, is to utilise every modern economical method in order to produce as cheaply as possible.

The main cost of the mechanical work at the clay pit itself is undoubtedly that of winding the sand out of the pit and pumping the clay stream from the bottom of the clay pit to the "micas." The customary method of performing this work in the olden days was, and even now in many cases is, to use a rotary engine (*i.e.*, an ordinary beam engine with a rotary motion) or two separate steam engines—one for pumping and the other for winding.

In addition to the improved methods of transport—both by longer pipe lines laid nearer to the port and kilns built alongside the railway—great strides have been made in the winding and pumping arrangements in many cases. There are many other phases of China Clay production that might be spoken of, such as the use of suction gas and oil engines in place of steam; gas engines coupled to Cornish pumps; direct winding by gas engines; oil engines and gas engines for generating electricity; the use of patent sand pits and flying tips for more cheaply disposing of the sand; the use of steam navvies and Canadian scoops for taking away overburden; and so on.

Deeper Pits

The clay pits working now which were working in the period when the *Treatise on China Clay* was written, are very considerably deeper than they then were. One hundred feet was the depth allowed for in the book, but now it would be difficult to find a clay pit opened 30 years ago which does not reach a depth of 200 feet or more. This means that additional springs of bottom water have been cut, and also an additional quantity of surface water in flood times, because of the enlarged area of the pit. A few years ago we gave an instance, at Lee Moor clay works, of what English China Clays, Ltd., had done in the way of modernising their arrangements by installing three suction gas engines of 250 h.p. each in a central power station for the purpose of generating electricity for all their requirements in this area. But this firm appears to have eclipsed

its own records recently by what took place at Dubbers clay pit. Of this remarkable piece of work we give such details as we have been able to obtain.

Old Cornish Pumps Superseded

It is generally understood in the China Clay trade that future economy in pumping lies more along the line of centrifugal pumping than by the old Cornish pumping. The latter method has admittedly been a good servant, but its great fault has been an excessive appetite for coal. Two of the largest China Clay works in the Mid-Cornwall area are Dubbers and Dorothy, both being about the same depth—240 feet—and both having Cornish pumps of the capacity of about 1,000 gallons per minute. For the purpose of economy, gas engines have been installed at Dorothy pit, centrifugal pumping by means of electricity being begun some months ago. It is understood that the Cornish pumping engine at Dubbers was to share the same fate—supersession! Towards this end a gas engine was installed some time ago, and the winding direct from the gas engine was started. Then came the question of changing over the pumping. This was anticipated within a period of about two months.

The Story of a Hustle

A short time ago the engine man, coming to work about 5 a.m., started his engine as usual, and then went down to fire the boiler, when he heard a terrific bang as if something had exploded. Men a long distance off on the way to work also heard it. The engine was brought to a standstill, and it was found that the main beam of the engine had broken right through on one side—a crack in the cast iron beam which weighed about 16 tons—the crack being about 4½ ft. long. Should this beam be mended, or should every effort be made to install another centrifugal pump? Which would take the longest time? Was everything on hand for the change over? A hurried consultation of the chairman and managing directors followed, and it was decided to install the new centrifugal pump with the utmost speed, as the water rising in the work, apart from rain at this time of the year, was about 400,000 gallons in 24 hours.

That day, Tuesday, the fitters, carpenters, and other men required for the job were already elsewhere, and the work could not be started in real earnest until the Wednesday. How long would it be before pumping would again be in operation? Tuesday was used to bring up the cable poles, copper cable, 6 in. steel pipes, electrical equipment, etc., and from Tuesday, night and day, there was no cessation of the work. One week was the estimated time to complete the job. Everything went well. The weather was not bad, although there was some rain. The house was made in sections for the pump and a frame made on the sand incline wagons, and the whole lowered into the pit about 400 feet; the column of pipes 1,500 ft. was erected; poles erected and cable attached; connections made and dynamo coupled up with all the other incidental work. By 6 p.m. Friday evening the large pool in the bottom of the pit was being decreased at the rate of 75,000 gallons per hour. A hot bearing on the motor gave two or three hours' hindrance, and then it was a continuous run until Sunday morning at 10, when all the water, amounting to about three million gallons, or 13¼,000 tons, had been pumped out of the pit!

A Remarkable Achievement

The new motor and pump are contained in a house 16 by 8 by 6. Alterations were made on the Monday for pumping out of the old level, and clay washing was resumed on the Tuesday. There is reason to believe that this performance has not been equalled. The pump itself is said to be of the largest capacity in the China Clay industry, and to have erected it, pumped out 3,000,000 gallons of water, and commenced washing clay again, all within one week, deserves to be placed on record as an achievement of which the firm responsible might be justly proud, in the organisation of which their works manager, Mr. Alfred Davies, can claim a great deal of credit.

China Clay Notes and News

Shipping Congestion at Fowey

The year opened with an acute congestion of shipping in the Port of Fowey, and on Sunday, January 1, no fewer than thirty-six vessels were in the harbour, either loaded with clay or awaiting loading, and representing a total carrying capacity of about seventy thousand tons, probably a record for the port. Included in this number was a Danish motor ship, the *Chile*, of 5,217 tons, the largest motor vessel using the port. Another was the five-master German auxiliary schooner, the *Carl Vinnew*, of 1,524 tons register. Other nationalities represented were Norway, Sweden, Japan, Holland, and Latvia.

English China Clays, Ltd.'s New Deal

Another China Clay deal has been carried through by English China Clays, Ltd., by the acquisition of Rosevear and Imperial China Clay Works in the neighbourhood of Bugle. The Rosevear Works have been managed by the Dyer family for a great number of years, first by the late Captain Samuel Dyer, for Singleton and Birch, who a few years ago disposed of the property to Captain Samuel J. Dyer and his friends, who have worked it since as a limited company. A few years ago Captain Dyer formed a company to take over the Imperial Works.

This new acquisition follows closely upon the acquisition by English China Clays, Ltd., of the North Goonbarrow and Great Halvigan China Clay Works.

New China Clay Company

The Great Longstone China Clays, Ltd., was registered as a private company on December 13, 1927, with a nominal capital of £12,500 in £1 shares. The objects are to adopt an agreement between Sir Wm. H. Peat (the receiver and the manager of the Goonamarth China Clay Co., Ltd.) of the one part and A. Courtney, P. C. Matts, and W. H. Maslen (as trustees for the company) of the other part, to purchase the leasehold China Clay works and property at Goonamarth Karslake and at Carthew near St. Austell together with the goodwill of China Clay pit owners and merchants carried on by the said company, and to carry on the business of China Clay pit owners, quarry masters, road and pavement makers, manufacturers of and dealers in lime, cement, concrete, etc. The first directors are A. Courtney, Melrose, Murray Road, Northwood (director of Merbau Rubber Estates, Ltd., North Perak Rubber Estates, Ltd., and the Gedong (Malaya) Rubber Estates, Ltd.); P. C. Matts, Selsdon Park Hotel, near Croydon; W. H. Maslen, 53, Northgate, Regents Park, London, N.W., underwriter at Lloyd's. Qualification (except permanent directors), £100. Remuneration (except managing director), £100 per annum divided between them. Secretary: A. W. Holmes, Moorcroft, Hadley Road, New Barnet. Solicitors: Barnet, Tuson and Co., 35, New Broad Street, London, E.C. Registered Office: Finsbury House, Blomfield Street, London, E.C.2.

Measuring the Rate of Sedimentation of Clay

Important conclusions may be drawn from the rate of sedimentation of China Clay. Professor Rudolf Lorenz draws attention, in the *Papier Fabrikant*, to this phenomenon of sedimentation of a substance in a viscous medium. The speed of formation of the deposit depends upon the density of the suspended substance, and also upon the density and properties of the medium in which it is suspended.

In other words, the rate of sedimentation is proportional (1) to the square of the diameter of the particles of the substance in suspension; (2) to the difference of density between the suspended substance and the suspension medium; and (3) in inverse proportion to the viscosity of the medium. On these principles, Professor Lorenz has constructed an instrument to record the rate of sedimentation of China Clay in water. He had observed that the progress of formation of a deposit varied in rate, and also that these variations were closely allied with the size and weight of the particles of clay. The principle of his apparatus consists in taking continuous photographs of the successive images of the upper meniscus of the mixture of kaolin and water, in a glass tube, from the moment of intimately mixing to that of complete formation of the deposit.

As the photographic plate is displaced horizontally by a clockwork mechanism, the successive images of the meniscus give a diagram which can then be compared with the diagram of other (standard) China Clays. The inventor even asserts that from the direction of the tangent to the diagram, both the size and weight of the particles of clay can be determined.

Colloidal Clay

In a paper before the Refractory Section of the Ceramic Society, Dr. A. F. Joseph, Sudan Government Chemist, made the following references to colloidal clay: "It has in the past been commonly assumed that clays contain a small proportion of extremely fine material to which their characteristic properties are due, high and low plasticity being associated with a larger or smaller proportion of this substance. This can no longer be held to be the case, as all plastic 'clays,' and some of weak plasticity, can be obtained in the form of very fine material. This has been shown in the writer's laboratory by passing a thin clay suspension through a Sharple's super-centrifuge, a very dilute suspension of colloidal clay being separated. If now the residue left in the centrifuge is shaken with more water and the process repeated, a further quantity of 'colloid clay' is obtained. In one trial 50 centrifuge runs were made with the same specimen, additional quantities of colloid being obtained each time. Owing to the nature of the apparatus the experiments cannot be carried out quantitatively, but the indications are that the whole of the original 0.002 mm. fraction is obtainable in the colloid form. Much remains to be done in the way of subdividing the fraction of clay into finer fractions, but it is almost certain that the 0.002 mm. fraction of a plastic material consists of particles fine enough to be considered 'colloidal,' and that the colloid content of a raw material may be taken as identical with its 'clay' content."

"The work of American investigators has shown that a relation similar to that found for 'clay' exists between the chemical composition of these colloid fractions and their physical properties. They use the molecular ratio of silica to alumina plus iron oxide as an index of the composition, but there is a close correlation between that and the simpler ratio of silica to alumina."

Properties of British China Clay

At the Columbus branch of the U.S. Bureau of Standards, work on the investigation of China Clay during the past few months has included the evaluation of properties at high temperatures. Specimens of the seventeen English clays being studied were fired to cones 18 and 23 (1,490° and 1,590° C.) and the softening points were obtained in the standard manner through a study of cone deformations.

A preliminary report states that the specimens were the standard size bars used for such determination. A schedule of 24 to 30 hours was used in making the burn. An average of five tests was taken to obtain figures for all properties, with the exception of the modulus of rupture, where the figure was taken from ten tests. The variation from one clay to another is so slight (less than 8 per cent. on the average) that it seems justifiable for the present purposes to average all seventeen clays for each property at each firing temperature, and upon this basis the following table is obtained:—

Cone.	3	5	8	11	14	18	23
Volume shrinkage (per cent.)	20.0	26.3	32.5	41.7	48.8	48.5	48.5
Porosity (per cent.)	40.29	35.92	28.96	17.49	3.85	1.22	1.01
Bulk specific gravity	1.60	1.75	1.91	2.17	2.45	2.50	2.50
Modulus of rupture	2219	2988	4181	5512	6146		

As would be expected, when the temperature of firing increases, the percentage volume shrinkage increases, the per cent. porosity decreases, the bulk specific gravity increases, and the modulus of rupture increases.

The softening point determinations were made in a small surface combustion furnace at a rate of heating of 150° C. per hour above cone 20, which is the rate used by the bureau. The clays showed remarkable similarity in this property, none of them softening below cone 33 and none above cone 35. The average is about cone 34, which corresponds to a temperature of 1,740° C. or 3,164° F.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay, with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—December, 1927

Arrived.	Name.	Sailed.	Destination.
December 1, s.s.	<i>Pearl</i>	December 7,	Antwerp
December 1, s.s.	<i>Beeston</i>	December 8,	Liverpool
December 1, s.s.	<i>Signfred</i>	December 9,	Oscarsham
December 1, s.s.	<i>Blush Rose</i>	December 10,	Weston Point
December 1, s.s.	<i>Wild Rose</i>	December 10,	Weston Point
December 1, s.v.	<i>Ellen</i>	December 8,	Charlestown
December 1, s.s.	<i>Knowl Grove</i>	December 8,	Gravesend
December 2, s.s.	<i>Horn</i>	December 8,	Bilbao
December 2, s.v.	<i>Pallasen</i>	December 8,	Charlestown
December 2, s.v.	<i>Clymping</i>	December 8,	Queenborough
December 2, s.s.	<i>Pembroke Coast</i>	December 9,	Liverpool
December 3, s.v.	<i>Merhur</i>	December 9,	Charlestown
December 4, s.s.	<i>Wyke Regis</i>	December 13,	Antwerp
December 4, s.s.	<i>Pansy</i>	December 12,	Leith
December 5, m.v.	<i>Drogden</i>	December 7,	Svenborg
December 6, s.s.	<i>Mersey</i>	December 10,	Ridham
December 7, s.s.	<i>Hayle</i>	December 10,	Runcorn
December 7, s.s.	<i>Austin Gough</i>	December 13,	Rouen
December 7, s.s.	<i>Emilie Dunford</i>	December 13,	Brussels
December 8, s.s.	<i>Farfield</i>	December 13,	Grimsby
December 8, s.s.	<i>Svenska</i>	December 13,	Göteborg
December 8, s.s.	<i>Crofter</i>	December 13,	Harburg
December 8, s.s.	<i>Rayford</i>	December 13,	Methil
December 8, s.s.	<i>Primrose</i>	December 12,	Fleetwood
December 8, m.v.	<i>Isabel</i>	December 9,	Par
December 9, s.s.	<i>Scheldesop</i>	December 14,	Terneuzen
December 9, s.s.	<i>Mars</i>	December 14,	Drammen
December 9, s.s.	<i>Joffre Rose</i>	December 13,	Bo'ness
December 11, s.s.	<i>Dorrien Rose</i>	December 15,	Antwerp
December 12, s.s.	<i>Baron Elco</i>	December 24,	Philadelphia
December 12, s.s.	<i>Fellside</i>	December 16,	Antwerp
December 12, s.s.	<i>Gronant Rose</i>	December 15,	Preston
December 12, s.s.	<i>Seaforth</i>	December 15,	Gravelines
December 13, s.s.	<i>Blairdevon</i>	December 20,	Boston Mass.
December 13, m.v.	<i>Carmen</i>	December 20,	Harburg
December 13, s.v.	<i>Lady Rosebery</i>	December 20,	Aylesford
December 14, s.s.	<i>Hoffnung</i>	December 21,	Hamburg
December 14, s.s.	<i>Gouwestroom</i>	December 21,	Amsterdam
December 14, s.s.	<i>Suffolk Coast</i>	December 20,	Liverpool
December 15, s.v.	<i>Marie</i>	December 20,	Göteborg
December 16, s.s.	<i>Brier Rose</i>	December 21,	Manchester
December 18, s.s.	<i>Mersey</i>	December 24,	Ridham
December 18, s.s.	<i>Charlwood</i>	December 24,	Brussels
December 18, s.s.	<i>Orontes</i>	December 22,	Dunkirk
December 18, s.s.	<i>Amstilstroom</i>	December 23,	Amsterdam
December 18, s.s.	<i>Foamville</i>	December 20,	Par
December 20, s.s.	<i>Carmen</i>	December 20,	Genoa
December 20, s.s.	<i>Wild Rose</i>	December 24,	Barrow
December 21, s.s.	<i>Haig Rose</i>	December 22,	Preston
December 22, s.v.	<i>Vega</i>	December 22,	Sarpsborg
December 22, s.s.	<i>Kiefuku Maru</i>	December 22,	Portland Me
December 22, s.s.	<i>Thurston</i>	December 22,	Portland Me
December 22, s.s.	<i>Primrose</i>	December 22,	Rouen
December 22, s.s.	<i>Edenside</i>	December 24,	Charlestown
December 22, s.v.	<i>Charmont</i>	December 24,	Ruscoff
December 22, s.s.	<i>Eleth</i>	December 24,	Par
December 22, m.v.	<i>San Antonio</i>	December 24,	Seville
December 22, s.s.	<i>Guelder Rose</i>	December 24,	Runcorn
December 22, s.s.	<i>Pembroke Coast</i>	December 24,	Liverpool
December 23, s.s.	<i>Drechtstroom</i>	December 24,	Amsterdam
December 23, s.s.	<i>James Dunford</i>	December 24,	Antwerp
December 23, s.s.	<i>Foch Rose</i>	December 24,	Runcorn
December 24, s.s.	<i>Coral</i>	December 24,	Harrington
December 24, m.v.	<i>Isolda</i>	December 24,	Göteborg
December 24, s.s.	<i>Grandon</i>	December 24,	Philadelphia
December 24, s.s.	<i>Enigheden</i>	December 24,	Oscarsham
December 25, s.s.	<i>Horn</i>	December 24,	Pasajes
December 25, s.s.	<i>Gronant Rose</i>	December 24,	Runcorn
December 25, s.s.	<i>Daguy</i>	December 24,	Rouen
December 26, s.s.	<i>Hamoy</i>	December 24,	Skien
December 26, s.s.	<i>Hayle</i>	December 24,	Preston
December 28, m.v.	<i>Carl Vinnen</i>	December 24,	Zarate
December 29, s.s.	<i>Wheatplain</i>	December 24,	Fleetwood
December 30, s.s.	<i>Afon Llidi</i>	December 24,	Brussels
December 30, s.s.	<i>Borglum</i>	December 24,	Philadelphia
December 30, m.v.	<i>Eurasia</i>		
December 30, s.s.	<i>Rayford</i>	December 24,	Tayport
December 30, m.s.	<i>Chile</i>	January 11,	San Francisco
December 31, s.s.	<i>Brilliant</i>	January 11,	Terneuzen
December 31, s.v.	<i>Elizabetta</i>	January 11,	Granton
December 31, s.s.	<i>Jellicoe Rose</i>	January 11,	Rouen
December 31, s.v.	<i>Penryn</i>	January 11,	London
December 31, s.s.	<i>Endymion</i>	January 11,	Hamburg

Charlestown Shipping—December, 1927

DATE.	VESSEL.	DESTINATION.
December 3.....	<i>Snowflake</i>	Runcorn
December 5.....	s.s. <i>System</i>	Terneuzen
December 5.....	<i>Kate</i>	London
December 10.....	s.s. <i>Stanwell</i>	Liverpool
December 12.....	s.s. <i>Jolly Laura</i>	Gravesend
December 15.....	<i>Daisy</i>	Goole
December 15.....	<i>Mary Ann</i>	Runcorn
December 16.....	s.s. <i>Pegrix</i>	Rochester
December 21.....	<i>Francis and Jane</i>	Garston
December 23.....	m.v. <i>Romanie</i>	Antwerp
December 23.....	<i>Isabella</i>	London
December 23.....	<i>Merhus</i>	Nantes
December 23.....	s.s. <i>Coaster</i>	Gravesend
December 23.....	<i>Palsen</i>	Kirkcaldy
December 24.....	<i>Ellen</i>	Aberdeen
December 24.....	s.s. <i>Edenside</i>	Sunderland
December 29.....	s.s. <i>Magrix</i>	Leith
December 29.....	<i>Waterwitch</i>	Newcastle

Par Harbour Shipping—December, 1927

Date.	Vessel.	From
December 1, m.v.	<i>Kate</i>	Falmouth
December 3, s.v.	<i>Noah</i>	Exeter
December 6, s.s.	<i>Wheatlands</i>	Penryn
December 7, s.s.	<i>Southwell</i>	Plymouth
December 8, s.s.	<i>Orchis</i>	Exmouth
December 8, m.v.	<i>Antigoon</i>	Torquay
December 8, m.v.	<i>Johanna</i>	Gweek
December 8, m.m.	<i>Isabel</i>	Fowey
December 8, s.s.	<i>Edern</i>	Charlestown
December 9, s.s.	<i>Seaforth</i>	Newport
December 11, s.s.	<i>Grosvenor</i>	Portsmouth
December 13, m.v.	<i>San Antonio</i>	Falmouth
December 20, s.s.	<i>Foamville</i>	Fowey
December 21, s.s.	<i>Cornish Trader</i>	Falmouth
December 21, s.v.	<i>Clytia</i>	Charlestown
December 24, s.s.	<i>Cornish Merchant</i>	Falmouth
December 24, s.v.	<i>Ivy</i>	Penryn
December 25, s.s.	<i>Elizabetta</i>	London
December 25, s.s.	<i>System</i>	London
December 29, s.v.	<i>Alf Everard</i>	Plymouth
December 30, s.s.	<i>Robrix</i>	Truro
December 30, s.s.	<i>Treleigh</i>	Portreath
December 31, s.s.	<i>Isabeletta</i>	Newport, I.O.W.

Date.	Vessel.	Destination.
December 1, s.v.	<i>Clymping</i>	Queenboro
December 1, s.s.	<i>Brideen</i>	Aberdeen
December 1, m.v.	<i>Regina</i>	Plymouth
December 2, m.v.	<i>Kate</i>	Plymouth
December 7, s.v.	<i>Greenhithe</i>	Rochester
December 8, s.v.	<i>Noah</i>	Fredrikshall
December 8, s.s.	<i>Wheatlands</i>	Larne
December 10, s.s.	<i>Southwell</i>	Pasages
December 11, s.s.	<i>Orchis</i>	Rouen
December 11, s.s.	<i>Edern</i>	London
December 12, s.s.	<i>Seaforth</i>	Fowey
December 13, m.v.	<i>Antigoon</i>	Antwerp
December 13, s.s.	<i>Grosvenor</i>	Runcorn
December 14, m.v.	<i>Isabel</i>	Poole
December 15, m.v.	<i>Johanna</i>	Grangemouth
December 21, m.v.	<i>San Antonio</i>	Fowey
December 24, s.s.	<i>Foamville</i>	Fleetwood
December 24, s.s.	<i>Cornish Trader</i>	London
December 29, s.v.	<i>Clytia</i>	Methil
December 29, s.s.	<i>Cornish Merchant</i>	Gravesend
December 29, s.s.	<i>System</i>	Penzance
December 31, s.s.	<i>Robrix</i>	Charlestown
December 31, s.s.	<i>Elizabetta</i>	Runcorn

Par Harbour Tide Table, February, 1928

Day of Week.	Month.	Day of	Morning.	Afternoon.	Height.
Wednesday	1	0.20	1.0	10.5	
Thursday	2	1.43	2.23	10.9	
Friday	3	3.2	3.40	11.6	
Saturday	4	4.9	4.39	12.1	
Sunday	5	5.7	5.31	12.6	

Monday	6	5.53	6.16	12.7
Tuesday	7	6.35	6.54	12.11
Wednesday	8	7.11	7.20	12.10
Thursday	9	7.43	7.58	12.7
Friday	10	8.14	8.30	12.2
Saturday	11	8.44	8.59	11.8
Sunday	12	9.15	9.32	11.0
Monday	13	9.51	10.10	10.4
Tuesday	14	10.34	10.58	9.8
Wednesday	15	11.28	—	9.2
Thursday	16	0.5	0.47	9.1
Friday	17	1.33	2.14	9.6
Saturday	18	2.51	3.27	10.4
Sunday	19	3.56	4.26	11.4
Monday	20	4.48	5.10	12.3
Tuesday	21	5.32	5.53	12.7
Wednesday	22	6.13	6.34	13.3
Thursday	23	6.52	7.10	13.8
Friday	24	7.29	7.48	13.9
Saturday	25	8.7	7.27	13.6
Sunday	26	8.45	9.5	12.11
Monday	27	9.25	9.48	12.1
Tuesday	28	10.11	10.40	11.0
Wednesday	29	11.14	—	10.2

E. CLEMENS, Harbour Master.

China Clay Exports for December, 1927

A RETURN showing the quantities and values of the exports of China Clay, including Cornish or China Stone, the produce of Great Britain and Northern Ireland, from Great Britain and Northern Ireland as registered during the month of December, 1927:—

COUNTRY OF DESTINATION.	QUANTITY.		VALUE.
	Tons.	£	
Finland	564	613	
Sweden	2,854	6,709	
Norway	3,017	5,169	
Denmark	601	1,685	
Germany	3,223	6,849	
Netherlands	5,730	12,219	
Belgium	9,140	14,884	
France	3,341	5,879	
Spain	3,084	7,747	
Italy	1,940	5,816	
Serb-Croat-Slovene State	1	9	
Greece	117	310	
Roumania	1	10	
China	—	4	
United States of America	16,251	31,651	
Peru	1	6	
Chile	10	80	
Transvaal	—	2	
Bombay, via Other Ports	6,945	20,760	
Madras	5	20	
Bengal	145	468	
Straits Settlements	1	14	
Australia	88	427	
Irish Free State	—	2	
Total	57,959	121,333	

December China Clay Deliveries Record Year

DECEMBER deliveries, which fell a good deal below November, and were not up to the deliveries made in the corresponding month last year (owing to wintry weather conditions this year), nevertheless brought the total deliveries for the year up to the huge total of 997,269, within nearly 2,800 tons of the million mark. This remarkable volume of tonnage is referred to in our editorial page. The highest previous record was in 1912 when a total tonnage of 963,895 (including 73,284 china stone) was dealt with. In that year the export of China Clay alone was 661,300 tons, value £745,822.

Details of December deliveries compared with 1926 are as follows:—

Port.	CHINA CLAY.		CHINA STONE.		BALL CLAY.		TOTAL.	
	Tons.	1927.	Tons.	1926.	Tons.	1927.	Tons.	1926.
Fowey	67,519	68,314	2,924	4,007	995	2,313	71,438	74,634
Par	5,485	2,927	—	—	—	—	5,485	2,927
Charlestown	5,064	4,223	—	—	—	—	5,064	4,223
Plymouth	3,170	2,182	—	—	—	—	3,170	2,182
Falmouth	1,156	1,800	—	—	—	—	1,156	1,800
By rail	5,028	4,679	—	—	—	—	5,028	4,679
11 months	87,422	84,125	2,924	4,007	995	2,313	91,341	90,445
12 months	832,652	786,103	51,627	37,752	21,649	19,960	905,928	843,915
12 months	920,074	870,228	54,551	41,759	22,644	22,273	997,269	934,360

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

ASHFORD AND NACCOLT BRICK TILE AND POTTERIES, LTD. (late ASHFORD AND DISTRICT BRICK AND TILE CO., LTD.).—Registered December 24, £650 debentures, part of £6,000; charged on properties at Naccolt, etc., also general charge. *£5,000. January 17, 1927.

COED TALON BRICK AND TILE WORKS, LTD., London, S.W.—Registered December 20, £30,000 debentures (filed under section 93 (3) of the Companies (Consolidation) Act, 1908), present issue £5; general charge.

COPPICE HILL BRICK AND TILE CO., LTD., Bishop's Waltham.—Registered December 12, £500 debentures; general charge (subject to 1st debentures). *£500. October 31, 1927.

DORSET BRICK STONE AND BALL-CLAY CO., LTD., Bournemouth.—Registered December 23, £5,000 1st debenture, to Branch Nominees, Ltd., 15, Bishopsgate, E.C.; charged on land at Mount Talbot, Alder Road, Branksome, also general charge.

FOREST AND GOVER VALLEY CHINA CLAY WORKS, LTD., London, E.C.—Registered December 10, £15,000 debentures; general charge.

PERRETT'S BRICK AND TILE CO., LTD., London, W.C.—Registered December 29, £7,000 (not ex.) debenture, being as to £5,000 a re-issue of debentures redeemed and as to £2,000 the unissued portion of same series, to Barclays Bank, Ltd.; general charge. *£5,000. December 13, 1927.

Satisfaction

FOREST CHINA CLAY WORKS, LTD., London, E.C.—Satisfaction registered December 13, £5,000, registered April 12, 1927.

London Gazette, &c.

Companies Winding Up Voluntarily

HORTON KIRBY PAPER MILLS, LTD. By special resolution December 12, confirmed December 28. S. H. Gillett, 24, Basinghall Street, London, E.C.2, appointed as liquidator.

SERVICE POTTERY CO., LTD. A. Ellison, 24-26, North John Street, Liverpool, Chartered Accountant, appointed as liquidator, December 10.

SUNDERLAND POTTERY CO., LTD. W. S. Piper, 62, John Street, Sunderland, Chartered Accountant, appointed as liquidator, December 12.

China Clay Imports for December, 1927

A RETURN showing the quantities and value of China Clay, including China Stone, imported into Great Britain and Northern Ireland as registered in the month of December, 1927:—

COUNTRIES WHENCE CONSIGNED.	QUANTITY.		VALUE.
	Tons.	£	
Belgium	110	163	
U.S. America	12	345	
Total	122	508	

American Ceramic Society's Visit

PRELIMINARY arrangements have been made for the tour of the American Ceramic Society in Great Britain next June. The visitors will arrive in London on June 21. Visits will be made to a number of works of various kinds, and a party will leave London on June 24 to visit the Cornish China Clay mines. The visitors will be entertained by clay organisations, by the Ceramic Society, and by the Society of Glass Technology. The party will return to America at the end of June.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests.
Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., Bouverie House, 154, Fleet Street, E.C.4. All communications relating to Advertisements, Subscriptions, etc., should be sent to the Manager, "The China Clay Trade Review," at this address. Telegrams—"Allangas, Fleet, London." Telephone—City 0244 (10 lines).

China Clay Economics

A PIQUANT little controversy has arisen recently in the China Clay district, initiated by an article by Mr. Paul Reed, prospective Labour candidate for the Bodmin division, in the *Daily Herald*, in which he sought to show that the setting up of an Association for the China Clay industry was on a par with tobacco and other combines, and that the editor of the *Cornish Guardian*, who is the leader of the Liberal party in the Bodmin Division, could not logically justify the one and condemn the other.

As the controversy reveals in a clean-cut fashion two complete points of view on economics in general and China Clay in particular, we give publicity to it here, because of the real distinction that is emphasised between a combination that exploits the public and one that safeguards an industry against exploitation to the detriment of those engaged in the industry.

The Difference

In the *Daily Herald* Mr. Paul Reed wrote: "Not long ago the chairman of the Liberal Party in the Bodmin Division fulminated, in the journal he edits, against the prices and profits of the tobacco and cotton trusts, and at the same time was a strong supporter of a proposed combine in the Cornish China Clay industry, which has been suffering badly from the waste and inefficiency of cut-throat competition. Challenged to say how he would prevent trusts, which he approved in principle, from exploiting the public, he replied that he would plead for morality and an ethical standard of business."

The editor of the *Cornish Guardian* (Mr. B. Lyne, who is the Mayor of Bodmin) replied in the following terms:—"Now, I am not quite sure what particular point Mr. Reed wanted to score, but it is obvious that in his anxiety to score at any cost he has, intentionally or unintentionally, ignored a most relevant fact. It is that there is a whole world of difference between the position of the tobacco trust and the China Clay industry. I object to the former because the trust seeks, and has put itself into a position to obtain, a very much higher return on its capital than, in relation to the position of the consumer, it is reasonably entitled to. If I thought the China Clay companies intended securing, through combination, a similarly unjustifiable return by charging exorbitant prices, I should have opposed the combine from the first."

Sound Economics

"But anybody who knows anything at all about the position of the China Clay industry—and I will charitably suppose that Mr. Reed, though Cornish, is not acquainted very closely with that position—knows that there is a very sound economic basis for the combination of the China Clay companies. There is here no question of an enormous trust out to make exorbitant profits from its product. This is simply a case of the elimination of the over-supplied market, in other words the prevention of that flooding of the market which must inevitably lead to dislocation and waste and, by its reaction, to a less secure and happy position for the working men of whom Mr. Reed and his party, strangely enough, consider themselves the exclusive

champions. Why should the China Clay companies, working in isolation from each other and without taking into consideration the real needs of the market, go on pouring their production upon that market when the demand made upon it has already been met? Do sound economics demand this of the industry? Of course they don't, and Mr. Reed knows this perfectly well."

The Critic's Defence

Mr. Reed has replied: "By a most perverse misreading you proceed on the assumption that I oppose combination in the China Clay industry. My *Daily Herald* article was throughout directed to showing that it is a waste of time to oppose industrial combination, and, in the passage you quote, my summary of the China Clay industry is: 'Suffering badly from the waste and inefficiency of cut-throat competition.'

"Your summary is: 'Why should the China Clay companies, working in isolation from each other and without taking into consideration the real needs of the market, go on pouring their production upon that market when the demand made upon it has already been met?' Precisely. We are obviously agreed there, and your whole argument thereafter applies not to my article, but to the people I was criticising in it—the Union of University Liberal Societies, who passed a resolution that they are 'in general opposed to industrial trusts and combines, believing that possible advantages of greater efficiency and reduced costs are more often than not counter-balanced by the temptation to raise prices and lower the status of the worker.'

"You and I, in opposition to the University Liberals, accept the elimination of wasteful over-production and competition as desirable, with the proviso on my part that there must be safeguards against exploitation of the public. That proviso you reject, and there we part company. I was dealing in the *Daily Herald* with the principle laid down by the University Liberals, and I maintain that there is not, in principle, "a world of difference" between a trust in tobacco and one in China Clay as you assert. There is nothing to prevent the latter, once its immediate difficulties have been got over, from imitating the former in the exploitation you denounce.

"My objection to the University Liberals is that they run away from the facts that trusts and combines are here, are increasing in number with unprecedented rapidity and that the only thing to do is to deal with 'the temptation to raise prices and lower the status of the worker.'"

China Clay Association's Limitation

Our own comment on Mr. Reed's contention that in principle there is not much difference between the China Clay Association and other industrial combines referred to, is that whereas the latter have the power to neutralise the effect of what little competition there is outside the combines, the China Clay industry is always up against the competition of domestic clays in foreign countries and of substitutes before British China Clays can reach a level of prices high enough to warrant the description of exploitation or profiteering, even if China Clay producers desired to depress demand by charging unreasonable prices.

The "Rational" Analysis of Clays

By W. Singleton

Most clays of any important commercial value contain the four minerals kaolin, quartz, feldspar and mica. As the "burning" and other properties of a clay and of the finished products are influenced by the presence of each of these minerals, it is important to know the relative amount of each present in a given clay. "Rational" analysis aims at the estimation of the amounts of these different minerals that are present in a clay, whereas the object of the ultimate or chemical analysis is to determine the amounts of the chemical constituents of the clay, quite irrespective of the mineral forms in which they occur.

The methods whereby rational analysis endeavours to attain its objective consist of treating the clay with various strong reagents such as hydrochloric and sulphuric acid and sodium or potassium hydroxide. The results of chemical analysis are frequently used in conjunction with those obtained by rational analysis, the methods of which vary somewhat in their details of manipulation.

A Divergence of Opinion

According to Mellor (*Quantitative Analysis*, p. 657) a crude form of rational analysis of clays was in use as early as the end of the eighteenth century, but there exists at the present time a divergence of opinion as to the merits of the method. The opinion has been expressed by Washington (*J. Amer. Ceramic Soc.*, 1, 405 (1918)) and various others that so-called rational analysis—an expression which he considers is misleading, preferring to call such an analysis "modal," as it aims at determining the "mode" or mineral composition—is untrustworthy and misleading. He contrasts the uncertainties of the rational analysis with the "ultimate" or chemical analysis which can be carried out with ease and great accuracy, and believes that chemical analysis can be readily reduced to mineralogical terms by a simple process of mathematical calculation that will yield information as to the mineral composition of a clay far more accurate and certain than the information obtained from the usual methods of rational analysis, even when the latter is properly carried out and the calculations correctly made. It has been the experience of others, however, that rational analysis is quicker than the usual method of chemical analysis, and if due regard be paid to its limitations and the factors effecting it, results of value to those employed in the control of clays may be obtained.

Rational Analysis an Approximation

Rational analysis of clays is not intended to furnish more than an approximation of the mineral constituents of a clay, as the results obtained by such methods are likely to be influenced by a number of factors. Kaolin itself varies in its resistance to reagents, both acid and alkaline, with its origin, the nature and concentration of the reagent, and the length of time and the temperature at which the mineral is treated with the reagent. The different forms of silica which are frequently present in clays vary in their resistance towards different reagents. A further factor of importance is the grain size of the mineral, which, as is fairly well known, greatly influences the extent and the rapidity of solution or attack of a mineral by reagents. It is well known that the smaller the particles of a substance, the more rapidly it dissolves. The difference in rate of solution with the grain size is accentuated (the solution rate gradient becomes steeper, particularly with ordinarily "insoluble" minerals) when the dimensions of the particles are of the same order of magnitude as those that constitute clay minerals.

Rational analysis gives reliable results only when the sample consists exclusively of a mixture of kaolinite and quartz sand; in other cases it is of value if the results are interpreted with the necessary regard for other minerals which may be present. It is of value in the control of ceramic mixtures, and the error introduced by considering small amounts of foreign minerals as feldspar and sand is of little importance in ordinary ceramic mixtures.

Details of the Method

Most methods for the rational analysis of clays and the estimation of the different minerals present involve the use of hydrochloric and sulphuric acids and alkali hydroxides for

the separation of the mineral constituents. According to Mellor this process consists of digestion of the clay with hot concentrated sulphuric acid, and subsequent washing alternately with sodium hydroxide solution and hydrochloric acid to remove the "clay substance." The removal of soluble silica by treatment with a hot solution of sodium hydroxide or with dilute hydrochloric acid to dissolve the carbonates may precede the digestion with sulphuric acid, or it may be followed by evaporation of the residue with hydrofluoric acid to remove quartz and other silica, and for the determination of alumina upon which the calculation of the feldspar present in the clay is based.

A number of methods for the rational analysis of clays have been in use for some time, and new methods and modifications of existing methods have been proposed at intervals. It is not proposed to describe here methods which it is assumed are fairly well known, but rather to describe modifications which lead to greater accuracy and reliability. Capsa, in the Report of the Société Chimique de Roumanie (1926), describes in detail the technique of a method for the rational analysis of clays and ceramic mixtures. It differs from the usual methods in that the solutions are filtered, instead of being decanted, after the treatment with hydrochloric acid and sodium hydroxide, thereby considerably increasing the speed and accuracy of the analysis. Capsa shows that from the complete chemical analysis of the original clay and the complete chemical analysis of the insoluble residue remaining after treatment with sulphuric acid, the nature and proportion of the various minerals present can be calculated.

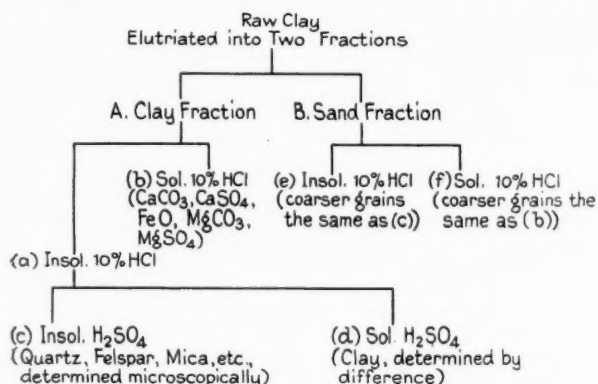
Modification of Koerner's Method

Koerner's method for the rational analysis of clays has been modified by Keppler and Ippach (*Sperehsael*, 55, 356 (1923)). A procedure which avoids the use of a large platinum dish and gives concordant results is recommended, as follows: 0.5 gram of the finely ground clay is weighed into a porcelain dish of about 100 c.c. capacity, moistened with distilled water, and thoroughly stirred to avoid the formation of lumps. After the addition to the mixture of 10 c.c. of concentrated sulphuric acid, the dish is covered with a clock glass and heated in an air-bath for several hours. The cover glass is then removed and the mixture evaporated to dryness. A small volume of concentrated hydrochloric acid is added to the residue, which is heated to dissolve any bases present.

The liquid is then filtered through a double filter and the residue washed with a hot 5 per cent. hydrochloric acid, and then with hot water. The filter paper and residue are transferred to a vulcanite dish of about 400 c.c. capacity, and stirred vigorously with a vulcanite rod during the addition of 200 c.c. of boiling water and 2.5 grams of 40 per cent. hydrofluoric acid. After standing for two minutes, a solution of sodium hydroxide is added drop by drop until the solution is neutral when tested with phenolphthalein. The solution is now filtered and the residue of quartz and feldspar washed with water, then with hydrochloric acid, and finally with water, after which the residue is ignited and weighed. The small quantity of hydrofluoric acid used is sufficient to remove any silica which may be liberated from the clay, but does not have sufficient time, in the two minutes allowed, to attack appreciably either the quartz or the feldspar.

For certain types of clay the method of Zschokkes (*Bau-materialienkunde*, 7, 149, 165 (1902)) has been found to give the most satisfactory results. This method is based upon the elutriation of the clay into two fractions, first, the clay fraction, and second, the sand fraction, both of which are then separately extracted with 10 per cent. hydrochloric acid. The first fraction, which may be designated A, is then subdivided into (a) insoluble in hydrochloric acid, and (b) soluble in hydrochloric acid. Fraction (a) is further subdivided into (c) insoluble in sulphuric acid, and containing quartz, feldspar, mica, etc., which may be determined microscopically; and (d) soluble in sulphuric acid (clay, which is determined by difference). The fraction (b) which is soluble in hydrochloric acid, is determined by difference by subtracting (a), the part insoluble in hydrochloric acid, from the first

fraction A. The portion soluble in hydrochloric acid (b) contains calcium and magnesium carbonates and sulphates and oxide of iron (FeO), which are determined microscopically. The sand fraction (B) is divided into (e) insoluble in hydro-



chloric acid, and which contains coarser grains, the same as (c) above; and (f) soluble in hydrochloric acid, which contains coarser grains, the same as (b) above. These fractions so obtained are designated as follows: (d) actual clay, (c) fine sand, (e) coarse sand, (b) fine fluxes, and (f) coarse fluxes. According to the author, by proper blending on a basis of this sort of analysis useful information may be obtained.

The various fractionations may be graphically expressed as in the chart above.

(To be concluded.)

Clays in Oil Refining

In the course of his recent Cantor lectures before the Royal Society of Arts, in London, Dr. A. E. Dunstan, chief chemist to the Anglo-Persian Oil Co., in dealing with the applications of finely divided clay in the modern refining of lubricating oils, said that whereas it was customary not long ago to refine heavy oil fractions by sulphuric acid, it had been found quite recently that the replacement of the soda by an adsorbent clay was quite effective, and the whole galaxy of materials formed by the action of sulphuric acid on the lubricating oils were adsorbed easily on the pore spaces and surfaces of these adsorbent materials. The result was that in the case of lubricating oils the final soda treatment was being rapidly replaced by the much more effective removal of these products by means of fuller's earth and clays applied in quite small concentrations.

Cornish M.P. in the Clay District

MR. G. PILCHER, M.P. for the Penryn-Falmouth Division, speaking in the China Clay area recently, said that the well-being of the people of the Mid-Cornwall China Clay fields had improved very considerably, as compared with the rest of the Duchy. In St. Dennis it was really astonishing how comfortable the people generally were. One saw many good houses going up, a work very largely due to the Government now in office. The workers all over the place were happy and the general standard of living was higher. Various institutions had been provided, and such contentment had been achieved by co-operation and not by strife, in spite of the difficulties experienced by producers in maintaining their works upon a profitable basis.

Pottery Imports to be Marked

A RECOMMENDATION that, under the Merchandise Marks Act, pottery imported into Britain should bear an indication of its origin is made by the committee appointed by the President of the Board of Trade to consider the application of the National Council of the Pottery Industry. The marking, it is recommended, should be conspicuously done for each article, and in order that the trade may have reasonable time for adaptation, the committee consider that the Order-in-Council should not come into force until six months after it is made.

U.S. Research on Clay Products

[CONCLUDED FROM LAST MONTH]

Last month an account of American Research on Clay Products carried out in 1926-27 was commenced in these columns. Below is given the conclusion of the article.

ELECTRICAL resistivity was investigated by King. He described a suitable method and conducted his measurements between 713°-990°. His findings include the statement that MgO spinel, talc and periclase showed the highest resistance. In this connection it might be proper to call attention to the suggestion of Tammann that in the study of the reactions between solids at elevated temperatures the electrical resistance be used as the means for establishing the presence of a liquidus.

Measurement of Heat Effect

The pyrometric cones used so generally in the ceramic industries for the estimation of time-temperature effects have been subjected to a critical study by Fairchild and Peters of the Bureau of Standards, which has demonstrated the reliability of these pyroscopes.

Research Activity

There has been a general realisation of the importance of fundamental as against empirical research and the Bureau of Standards, the University of Illinois, Ohio State University, Rutgers College, the Massachusetts Institute of Technology and others have under way studies which deal with the chemical and physical properties of the basic materials and products. A bibliography of the literature on refractories has been published by the American Ceramic Society. It might be of interest to note that in Germany a division for the scientific study of the silicates has been established in the Kaiser Wilhelm Institute.

Industrial Activities

Steady progress is being made in the development of continuous filtering systems, the removal of occluded air from plastic bodies, the casting or pouring of refractories, the further development of the tunnel kiln, the construction of a commercial, electrically heated, tunnel kiln, and the production of super refractories. In the latter field, highly aluminous products are being manufactured through the use of minerals like analusite, cyanite and dumortierite, as well as by means of synthetic mixtures of bauxite, diaspore and clay.

Suggested Fields of Research

The following matters are suggested as requiring investigation:—

1. The principles governing the flow of plastic bodies through orifices.
2. The effect of occluded air in plastic clays.
3. Precise studies of the deflocculation and coagulation of typical clays.
4. The electrical conductivity of clay suspensions and of clays in the plastic state for different water contents.
5. Study of the time-temperature effect in the heating of typical clays and ceramic bodies.
6. Further microscopic and X-ray spectra studies of the structure of clays and ceramic bodies fired to different temperatures.
7. Phase rule studies of simple silicates, borates and boro-silicates in the fused state.
8. Determination of the electrical conductivity of typical silicates and their mixtures during the stages of vitrification and incipient fusion.
9. Study of the dissolved and occluded gases in fused glazes and enamels.
10. Determination of the thermal expansion of typical clays, feldspars and the different varieties of silica fired to a series of temperatures.
11. Determination of the thermal expansion of simple silicates, borates and boro-silicates at temperatures up to their softening point, with special reference to the principal silicates and borates of glazes and enamels.
12. Precise determination of the resistance of typical clays and bodies to the several mechanical stresses.
13. Determination of the surface hardness of fired clays, glazes and enamels.
14. Determination of the cause of the rapid thermal expansion of refractory clays between 100° and 200° C.
15. Determination of the viscosity of fused glazes and enamels.

China Clay Notes and News

American Ceramic Society's Visit

Arrangements are well in hand for a visit of members of the American Ceramic Society to the Duchy on the occasion of their tour of England in June next. Arrangements have been made with Sir Felix Pole, the General Manager of the G.W.R., to take charge of the party from London on June 23, and convey them to Newquay for Sunday. The A.C.C., Ltd., are to entertain them at Newquay. From there they will pay visits to various parts of the county, an important part of their itinerary being a visit to the China Clay works, which will take place on June 25. The entertainment committee of the A.C.C., Ltd., charged with making the arrangements, are Mr. W. Sessions, Mr. J. S. Lovering, Mr. F. Parkyn, Mr. J. Rogers and Mr. J. Hoyle.

Clay Steamship Dry-Docked

The Japanese steamship *Glasgow-Maru*, which struck a rock when leaving Fowey harbour for America on December 10 last, and sustained considerable damage below the water line, left Fowey recently for Plymouth for dry-docking and repairs. A rent in the ship's side was successfully patched to enable the ship to be floated, and the whole cargo of over 7,000 tons of China Clay has been discharged. About 4,000 tons in the after holds which was not affected by water was transhipped to another steamer, while all the damaged cargo was discharged into lighters and dumped at sea. The whole of the salvage work has been undertaken by Captain F. C. Collins, harbour master, and the staff of the Harbour Board.

St. Austell Railwaymen and Road Transport

At the recent dinner of the traffic and road motor staffs of the Great Western Railway at St. Austell the chair was taken by Mr. A. F. Davey, station master at St. Austell. Presenting the toast of the Great Western Railway, the speaker referred to the Road Transport Bill which the railways had presented to Parliament, and pointed out that the railway companies were very large ratepayers and had to pay for the upkeep of the roads which the railway competitors used, which meant that the railway companies were subsidising road transport. Any man or firm could get a licence for a lorry for use on any roads, yet when the railway companies asked for similar facilities their request was turned down, which was an unfair position.

G.W.R. Big Traffic Scheme for St. Austell

Not having received any written communication from the G.W.R. with reference to their scheme for a new goods station yard and sidings at Polkyth, about which a joint deputation of the Urban and Rural Councils met the engineer at Plymouth, the Clerk (Mr. G. B. Dobell) reported at the last meeting of St. Austell Urban Council that the engineering department at Plymouth had replied that the scheme was under consideration and plans were in course of preparation, but they were not in a position to say when the work would be put in hand. Mr. F. W. Mutton (the chairman) said that when the deputation met the engineer at Plymouth there was no doubt that a scheme was to be undertaken in the relatively near future. Whatever steps they could take in getting the G.W.R. to expedite the preliminary work in connection with the scheme, they would be wise to take, and thereby receive the thanks of the unemployed, as unemployment had risen to such dimensions in the district. The scope of the scheme the G.W.R. contemplated undertaking was immense, for it would involve years of work, and many thousands of pounds expenditure. He suggested that in conjunction with the Rural District Council they should try to bring whatever pressure they could on the G.W.R. to get on with the scheme.

Councillor Hodge welcomed the chairman's proposal, and emphasised the urgent necessity of commencing work on the scheme as soon as possible in order to alleviate the great distress in the district arising out of unemployment of men who were willing to work. He understood that the number of unemployed in the district had risen, the number being nearly 600. It was decided that the Urban Council should co-operate with the Rural District Council in the matter and do everything possible to get the G.W.R. to start the preliminary work without delay.

China Clay Works Rating

The concern felt in China Clay circles at the prospect of a new system of rating proposed by the St. Austell rating authority, comments on which were made a few months ago in this journal, has to a large extent been removed by the announcement that an agreement has been reached between the China Clay producers and the St. Austell rating authorities as to the basis of the future valuation of China Clay works.

The committee of some of the directors of the producers' Association has reported that it had various conferences with senior and junior counsel on the subject, in co-operation with Mr. Gerald Eve, one of the recognised rating expert valuers. After a tedious correspondence with the St. Austell rating authorities, a conference was held, following which, acting on the advice of the legal advisers and with the approval of Mr. Eve, the following basis of valuation was agreed to:—

The tonnage of the preceding year will be taken, multiplied by a certain "figure," which will be the basis for the future rating, and in arriving at this figure regard will be had to fair royalties, the quality of the clay produced, the rental value of each part of the equipment that is rateable, and to all disadvantages connected with each particular works, as well as any excess of equipment over trade requirements.

The "certain figure" in each case will be the subject of discussion between Mr. Eve on behalf of the China Clay producers, and Mr. Body, acting on behalf of the rating authorities. No producer is to be committed without his approval. It will be a relief to the industry, and to the community of interests associated with it, to know that an amicable arrangement has been come to whereby costly and acrimonious controversy and litigation is avoided. The new system differs in some details from the one that has been in vogue for a great number of years in the China Clay district, but as the tonnage basis is an integral part of the new system as well as of the old, it should be generally acceptable and should operate equitably to the just claims of the industry on the one hand and the rating authority on the other.

China Clay Proprietor and the Outlook

Mr. Walter Sessions, joint managing director of English China Clays, Ltd., who recently returned from a business trip to the Continent, has been giving his views on the immediate prospects of overseas markets. In an interview, Mr. Sessions said: "It is recognised to-day perhaps more than ever that most English clays have virtues superior to those produced in other countries, but it must not be overlooked that domestic clays of various parts of the world have been extensively developed in recent years. Consumers have partly been attracted by the popularity of lower prices, although lower prices may prove to be more expensive in the long run. At the same time many buyers had thought it well to delay contracting until the trade generally became more settled. The demand in England, Scotland and Europe is definitely better than last year, and the buyers generally, in these parts of the world, have seen the wisdom of protecting themselves in registering their requirements over 1928. This policy is obviously a wise one, as producers have to lay their plans and organise their production many months ahead if users are to be kept supplied satisfactorily."

"The high retention qualities of British China Clays, apart from their colour and fineness, are certainly a strong feature of this valuable product. Some of the higher graded clays have been reduced in price for 1928, but as a general policy prices have been raised to only a bare economical level. It is natural that some should resent a rise, but in the case of China Clay it has been common knowledge the world over that an advance is a necessity and had to be made to avoid disaster, and it is believed that in this necessity the producers have the sympathy of their customers."

As regards prospects in France, Mr. Sessions said that unfortunately the country was greatly disturbed in its trade in consequence of a rise in the exchange value of the franc, and also the introduction of paper from other countries. Manufacturers in France had sent a deputation to their Government on the subject. In America the trade for the present was affected by an over-production of paper. This had in consequence so reduced the price of paper that the American paper manufacturers were said to be perturbed.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay, with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—January, 1928

Arrived.	Name.	Sailed.	Destination.
January 1,	s.s. <i>Belvedere</i>	January 14,	La Pallice
January 1,	s.s. <i>Marena</i>	January 3,	Landerneau
January 1,	s.s. <i>Joffre Rose</i>	January 12,	Bo'ness
January 3,	s.s. <i>Kenix</i>	January 14,	Antwerp
January 3,	s.s. <i>Torpoint</i>	January 4,	Newlyn
January 4,	M.V. <i>Isabel</i>	January 5,	Truro
January 5,	s.s. <i>Farfield</i>	January 14,	Grimshy
January 5,	s.s. <i>Beaufort</i>	January 14,	Pasajes
January 5,	s.s. <i>Blush Rose</i>	January 14,	Preston
January 5,	s.v. <i>Mela</i>	January 26,	Göthenburg
January 11,	s.s. <i>Vlietstroom</i>	January 14,	Amsterdam
January 12,	s.v. <i>Postedon</i>	January 20,	Marstal
January 13,	s.s. <i>Seaforth</i>	January 14,	Terneuzen
January 13,	s.s. <i>Goole</i>	January 18,	Hull
January 15,	s.s. <i>Guelder Rose</i>	January 21,	Preston
January 15,	M.V. <i>B.25</i>	January 30,	Nantes
January 16,	s.s. <i>Hermspool</i>	January 21,	Portland Me.
January 16,	s.s. <i>Byosund</i>	January 24,	Portland Me.
January 16,	s.s. <i>Cisneros</i>	January 18,	Genoa
January 17,	s.s. <i>Mersey</i>	January 19,	Weston Pt.
January 17,	s.s. <i>Coccinelle</i>	January 19,	Antwerp
January 18,	s.s. <i>Abercraig</i>	January 19,	Brest
January 18,	s.s. <i>Foch Rose</i>	January 21,	Runcorn
January 19,	s.s. <i>Brier Rose</i>	January 23,	Weston Pt.
January 19,	s.s. <i>Dowanhill</i>	January 28,	Philadelphia
January 20,	s.s. <i>Pembroke Coast</i>	January 21,	Liverpool
January 23,	s.s. <i>Pansy</i>	January 24,	Leith
January 23,	s.s. <i>Eskbridge</i>	February 1,	Portland Me.
January 23,	s.s. <i>Clan Buchanan</i>	January 27,	Bombay
January 23,	s.s. <i>Sturdee Rose</i>	January 26,	Brussels
January 23,	s.s. <i>Dagny</i>	January 24,	Harburg
January 23,	s.s. <i>Yewhill</i>	January 26,	Port Talbot
January 26,	s.s. <i>Austin Gough</i>	January 28,	Antwerp
January 27,	s.s. <i>Hayle</i>	February 2,	Manchester
January 28,	s.s. <i>Primrose</i>	January 31,	Bo'ness
January 28,	s.s. <i>Blush Rose</i>	February 1,	Grangemouth
January 28,	s.s. <i>Mersey</i>	February 4,	Weston Pt.
January 29,	s.s. <i>Wild Rose</i>	February 3,	Preston
January 29,	s.s. <i>Foch Rose</i>	February 4,	Weston Pt.
January 29,	s.s. <i>Rayford</i>	February 3,	Leith
January 30,	s.s. <i>Yeiuku Maru</i>	February 3,	Philadelphia
January 30,	s.s. <i>Chicago City</i>	February 4,	Boston, Mass.
January 30,	s.s. <i>Scheldejot</i>	January 31,	Terneuzen
January 30,	s.s. <i>Magrix</i>	February 1,	Gravesend
January 30,	s.s. <i>Palm</i>	February 4,	Glasgow
January 30,	s.s. <i>Gowestroom</i>	February 4,	Amsterdam
January 30,	M.V. <i>Mayblossom</i>	February 4,	Plymouth
January 30,	M.V. <i>Amazon</i>	February 3,	Pentwan

Charlestown Shipments—January, 1928

Date.	Vessel.	Destination.
January 3,	s.s. <i>Eleth</i>	Runcorn
January 5,	s.s. <i>Christina</i>	Runcorn
January 5,	s.s. <i>Robrix</i>	Rochester
January 6,	s.s. <i>Millocrat</i>	Liverpool
January 10,	<i>Lydia Cardell</i>	Sunderland
January 11,	<i>Englishman</i>	Preston
January 18,	s.s. <i>Airston</i>	London
January 23,	<i>Perseverance</i>	Preston
January 25,	s.s. <i>Stanwell</i>	Nantes

Par Harbour Shipping—January, 1928

Date.	Vessel.	From
January 1,	s.s. <i>Mount Charles</i>	Newport
January 4,	s.s. <i>Brier Rose</i>	Penzance
January 6,	s.s. <i>Pine</i>	Plymouth
January 6,	s.s. <i>T. P. Tilling</i>	Guernsey
January 7,	s.s. <i>Southwell</i>	Cowes
January 7,	s.s. <i>Enterprise</i>	Truro
January 7,	s.v. <i>John Sims</i>	Penryn
January 9,	M.V. <i>Isabel</i>	Falmouth
January 9,	s.v. <i>Lady Agnes</i>	Mevagissey
January 23,	s.s. <i>Farfield</i>	Goole
January 28,	s.s. <i>Magrix</i>	Penzance
January 31,	M.V. <i>Grit</i>	Newport, I.O.W.

Sailings

Date.	Vessel.	From
January 3,	s.v. <i>Icy</i>	London
January 3,	s.s. <i>Treleigh</i>	Preston
January 5,	s.v. <i>Alt Everard</i>	Rochester
January 6,	s.s. <i>Mount Charles</i>	Fleetwood
January 7,	s.s. <i>Brier Rose</i>	Garston
January 7,	s.s. <i>Isalella</i>	Fleetwood
January 10,	s.s. <i>Pine</i>	Preston
January 11,	s.s. <i>T. P. Tilling</i>	Runcorn
January 11,	s.s. <i>Southwell</i>	Nantes
January 11,	M.V. <i>Isabel</i>	Plymouth
January 13,	s.s. <i>Enterprise</i>	Rochester
January 25,	s.v. <i>John Sims</i>	Runcorn
January 27,	s.s. <i>Farfield</i>	Weston Point
January 30,	s.s. <i>Martin</i>	Fowey

Penzance Shipping—January, 1928

Arrived.	Name.	From.	Sailed.	Destination.
December 30,	s.s. <i>Ophir</i>	Newport	January 5,	Ridham
December 31,	s.s. <i>Mersey</i>	Ridham	January 3,	Preston
January 17,	M.V. <i>Heather Pel.</i>	King's Lynn	January 19,	Northfleet
January 17,	M.V. <i>Garthavon</i>	Falmouth	January 19,	Ridham
January 31,	s.v. <i>C. & F. Nurse</i>	Falmouth	February 3,	Rochester

Par Harbour Tide Table, March, 1928

(Greenwich Mean Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Thursday	1	—	0.37	9.9
Friday	2	1.26	2.13	10.2
Saturday	3	2.56	3.34	11.0
Sunday	4	4.6	4.33	11.9
Monday	5	4.57	5.19	12.4
Tuesday	6	5.39	5.58	12.7
Wednesday	7	6.61	6.33	12.11
Thursday	8	6.48	7.2	13.1
Friday	9	7.16	7.30	12.11
Saturday	10	7.44	7.58	12.7
Sunday	11	8.12	8.26	12.0
Monday	12	8.40	8.55	11.4
Tuesday	13	9.11	9.29	10.7
Wednesday	14	9.49	10.12	9.9
Thursday	15	10.39	11.12	9.1
Friday	16	11.53	—	8.10
Saturday	17	0.40	1.30	9.3
Sunday	18	2.16	2.55	10.2
Monday	19	3.28	3.57	11.5
Tuesday	20	4.21	4.44	12.6
Wednesday	21	5.6	5.27	12.5
Thursday	22	5.48	6.8	13.9
Friday	23	6.28	6.47	14.3
Saturday	24	7.6	7.25	14.3
Sunday	25	7.44	8.4	13.11
Monday	26	8.24	8.44	13.2
Tuesday	27	9.5	9.28	12.0
Wednesday	28	9.53	10.22	10.10
Thursday	29	10.58	11.41	9.10
Friday	30	—	0.30	9.7
Saturday	31	1.19	2.5	10.0

E. CLEMENS, Harbour Master.

China Clay Exports for January, 1928

A RETURN showing the quantities and values of the exports of China Clay, including Cornish or China Stone, the produce of Great Britain and Northern Ireland, from Great Britain and Northern Ireland as registered in the month of January, 1928.

COUNTRY OF DESTINATION.	QUANTITY.	VALUE.
	Tons.	£
Sweden	1,594	2,785
Norway	1,556	2,447
Denmark (including Farøe Islands)	2	16
Germany	2,984	5,944
Netherlands	7,433	16,397
Belgium	5,120	8,119
France	3,890	7,179
Spain	1,775	4,349
Italy	2,979	6,648

(China Clay Exports—continued)

Greece	6	47
Bulgaria	1	6
Roumania	7	51
China	5	26
United States of America	31,888	60,285
Cuba	11	85
Ecuador	3	6
Peru	12	24
Brazil	7	35
Argentine Republic	1,294	2,319
Cape of Good Hope	—	3
British India	1,827	7,441
Bengal, Assam, Bihar and Orissa	590	2,008
Straits Settlements and Dependencies	2	27
Australia	30	177
Total	63,030	126,432

Muscovite or Common Mica*An Account of Its Properties*

MUSCOVITE (potash or common mica) is, like felspar, a silicate of alumina and potash, but the former may be distinguished by its laminated structure and glittering metallic appearance. When held up to a bright light mica may display asterism, star-like rays of light being transmitted. This mineral is widely distributed, exhibiting various forms, but is usually crystalline or laminated, and though colourless of itself the presence of oxides imparts different colouring ranging from silver white to black.

The micas are divided into two groups and these again into various subdivisions. Even in the latter, considerable variation is displayed in chemical composition, as is shown by the following analysis of common mica taken from different sources:—

PERCENTAGE COMPOSITION.						
Silica	44.60	44.64	46.23	48.07	47.95	47.19
Alumina	36.23	30.18	33.03	38.41	34.45	33.80
Ferric oxide	1.34	6.35	3.48	—	1.80	4.47
Chromic oxide	—	—	—	—	3.95	—
Manganous oxide	—	—	—	—	—	2.58
Magnesia	0.37	0.72	2.10	—	0.71	—
Lime	0.50	—	—	—	0.59	0.13
Potash	6.20	12.40	8.87	10.10	10.75	8.35
Soda	4.10	—	1.45	—	0.37	—
Fluorine	—	—	—	—	0.35	0.28
Water	5.26	5.32	4.12	3.42	—	4.07

When mica occurs in large thin laminae, these are easily separated and can be readily split into thin flexible sheets, rendering them applicable for numerous industries. It is for electrical purposes, however, that this mineral is most extensively used. An electric insulator of outstanding merit is obtained by its use, as mica is incombustible, a very high temperature being necessary to melt it. Claim is made that this mineral withstands high voltage electricity better than any other material. According to a German authority a small plate of perfectly clear, transparent mica 0.038 mm. in thickness cannot be pierced even by an alternating current of 10,000 volts. In its natural state, however, perfectly pure mica is a rarity. Metallic oxides are usually scattered here and there between the flakes, and consequently insulating efficiency is proportionately decreased. On this account it has been found expedient to divide the various layers of mica, to remove any impurities, and to rejoin the individual parts.

Micanite

The difficulty of obtaining large enough pieces of a material equivalent to mica as an insulating substance led to the introduction of micanite. Small thin splittings can be utilised in the manufacture of this substitute. Layers are built up of the necessary thicknesses by sticking together in sheets the individual scales of the natural mica with a suitable binder such as shellac, resins, etc., and submitting the mass to pressure and heat. During the process any metallic oxides are removed. Not only is this mica substitute manufactured in sheets, but pipes, rinsers, collector rings, and special shapes are turned out. Other products marketed are paper, linen, gutta-percha and asbestos, all of which contain micanite. Mica waste is also utilised by being reduced to powder and submitted to different processes by which it is rendered suitable as a filler for various chemical preparations, etc.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Company Winding Up Voluntarily

IDRIS TILE AND SLABBING CO., LTD. E. G. Clegg, Chartered Accountant, 3, York Street, Manchester, appointed as liquidator, January 9.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

COOKE AND NUTTALL, LTD., Horwich, paper makers. Registered January 20, series of debentures for £35,000, present issue £27,000; general charge. *£16,000. September 16, 1927.

HSIPAW PAPER AND PULP CO., LTD., London, E.C. Registered January 24, series of £20,000 debentures, present issue £6,000; general charge (subject to 1st debentures). *Nil. March 10, 1926.

HSIPAW PAPER AND PULP CO., LTD., London, E.C. Registered January 23, £5,000 debenture, to H. Heather, St. Margarets, Canadian Avenue, Catford; general charge. *Nil. March 10, 1926.

RICHARDSON (A. G.) AND CO., LTD., Burslem, earthenware manufacturers. Registered January 18, £15,000 (not ex.) collateral mortgage, to Bank; charged on 31, 33 and 35, Pinnox Street, Tunstall. *£12,500. October 2, 1927.

Satisfactions

HSIPAW PAPER AND PULP CO., LTD., London, E.C. Satisfaction registered January 23, £5,000 registered December 7, 1926.

COOKE AND NUTTALL, LTD., Horwich, paper makers. Satisfaction registered January 20, £15,000 registered August 21, 1924.

January Deliveries of China Clay
Well Above the Average

THE effect of the rush of orders at the year end will not be felt until this month, there having been a large volume of orders left over from 1927 and executed in January into ships stemmed at December 31, to which the 1927 prices extended. Consequently the tonnage shipped for the first month of the year was above the average, being well above the corresponding month last year and under 20,000 tons below the bumper month of December.

Port.	CHINA CLAY.		CHINA STONE.		BALL CLAY.		TOTAL.
	1928.	1927.	1928.	1927.	1928.	1927.	
Fowey	56,965	46,976	2,754	4,147	2,179	2,569	61,898
Par	3,525	3,800	255	148	—	—	3,780
Charlestown	2,483	5,016	—	—	—	—	2,483
Penzance	1,515	1,710	—	—	—	—	1,515
Plymouth	702	1,699	—	80	—	—	702
Falmouth	1,425	1,377	—	—	—	—	1,425
Newhaven	—	186	—	—	—	—	186
By rail	3,963	5,191	—	—	—	—	3,963
January	70,578	65,955	3,009	4,375	2,179	2,569	75,766
December	—	87,422	—	2,924	—	995	91,341

China Clay Imports for January, 1928

A RETURN showing the quantities and value of China Clay (including China Stone) imported into Great Britain and Northern Ireland as registered in the month of January, 1928, is as follows:—

COUNTRIES WHENCE CONSIGNED.	QUANTITY.		VALUE.
	Tons.	£	
Germany	2	20	
U.S. America	22	134	
Total	24	154	

The China Clay Trade Review

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All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., Bouverie House, 154, Fleet Street, E.C.4. All communications relating to Advertisements, Subscriptions, etc., should be sent to the Manager, "The China Clay Trade Review," at this address. Telegrams—"Allangas, Fleet, London." Telephone—City 0244 (10 lines).

China Clay Competition

THERE is still an idea prevalent that the China Clay industry of Cornwall and Devon enjoys a monopoly as regards markets for its products, and that they are subject to no serious menace either in the home or overseas markets. To those engaged in the industry, this idea is well known to be a wholly unfounded one, as exporters of China Clays to American and continental markets are made to realise more and more as deposits in other countries are discovered and developed. It is proof of the high standard of quality of English China Clays that they are the clays in comparison with which foreign domestic clays are judged, and wherever the question arises as to the suitability of these foreign clays, the question is invariably raised as to their suitability as compared with the English product.

U.S. Domestic Clays

For some years there has been a big movement in the U.S.A. for the development of domestic clays in order to counteract the importation of English clays. As it is always an advantage to know what one's competitors are doing, the development of the China Clay industry in America, as disclosed in a paper to one of the American pulp and paper associations at an annual conference last year, should prove interesting and profitable to readers of this journal. From this we gather that during the period 1875-85, three or four progressive clay miners in the South Amboy (New Jersey) clay district erected clay washing plants to remove the impurities from a fairly white clay occurring in that locality. The product was called "New Jersey washed Ball Clay," and was largely sold to the potteries, a small proportion going to the paper trade. During the next few years, clay washing operations were applied to the rather residual deposits of Delaware, Maryland and North Carolina. Most of the product was sold for pottery purposes, the North Carolina plants still constituting an important source of supply for that trade.

In 1892 at Edgar, Florida, a plant was erected which has ever since served the pottery, hotel, china, floor and wall tile, and electrical porcelain trades. In none of these plants was the clay produced suitable for paper use. The first clays in the U.S.A. used for filler purposes in the crude state by the paper trade were from the South Carolina territory. One property in this state is said to have operated almost continuously since Civil War days. In 1909-1910, three washing plants were established in the State of Georgia, all of them within a radius of less than 30 miles. The output of each was of necessity very small at the start. Prejudice against American clays in the paper mills was almost universal. Undoubtedly part of this prejudice was justifiable, as the preparation of this clay was not as thorough at the beginning as that of the English clay. Furthermore, the physical characteristics of the American product differed from the English products, requiring variation of treatment in their use.

How Home Disturbances Hit Markets

In the paper referred to, acknowledgement is made of the impetus that was given to the development of the American domestic clay quarries, first, by the War, and then by labour troubles after the War through the incidence of which supplies to America were interrupted, and users

of China Clay were compelled to seek other avenues to keep their mills going. It emphasises the great injury done to home industries with an overseas trade when anything happens to interrupt the free flow of exports, as labour disturbances always do. The effect of the causes mentioned on the development of China Clay quarries in America has undoubtedly been detrimental to the expansion of English China Clay markets in that country as regards certain grades of China Clay which are not of first quality.

What American Paper Makers Want

Since the War, great efforts have been made by American producers to produce a China Clay, by the introduction of washing plants, which will meet the exacting requirements of paper-makers, especially those engaged in making coating papers, for which huge quantities of what are known in the trade as "coating" clays are required. It should be helpful to home China Clay producers supplying the American market to know what qualities American paper-makers look for and require in a good "coating" clay, as stipulated in their orders to producers of domestic clays who have sought their patronage. The characteristics they look for are set out in the following seven clauses:— (1) The clay must have a bright colour, free from tinting; a good bright natural is generally preferable to a blue white; (2) the clay must run absolutely uniform with respect to colour and quality; (3) it must be free from dirt and sharp grit; (4) it must make a free flowing paint when mixed in proportions of 100 parts of dry clay to 140 parts of water, and the equivalent of 15 parts of dry casein, properly cut with alkali; (5) the clay must be sufficiently colloidal to make a colour which will spread well on the paper and give an even, smooth, high finish to the sheet after the latter has been calendered; (6) it must be free from water-soluble chemicals which might cause deterioration of the raw stock or coating material; (7) it must be available in quantity, at a price which the trade can afford to pay.

American Producers' Criticisms Refuted

A good deal is made by producers of American clays of the alleged uncertainty and irregularity of supplies of the English product, but all buyers of clays in America know very well that these so-called difficulties exist only in the imagination of over-zealous pushers of American domestic clays who realise that they are up against a clay of unassailable quality in the best English clays. This is borne out by the somewhat naive confession of one of the leading producing firms in America, in which, after having extolled the virtues of the American product, they say:

"Practically all users of clay know that the American product does not act the same way as does the English, and in attempting to use this clay for coating work, difficulties will have to be overcome. This is easily accomplished by more violent agitation and possibly by deflocculating the clay to a moderate extent by the use of sodium silicate."

It is the special treatment to which much of the American China Clay has to be subjected when used in papermaking that makes all the difference between the American and English product, the latter being marketed in such a condition as to render unnecessary any artificial methods of preparation to make it suitable for the coating paper trade.

Americans and China Ware

Its Relation to Cornish and Devon Clays and Stone

THE question as to whether the American potters are likely to tackle the manufacture of bone china more and more in the future was raised at a recent meeting at the North Staffordshire Technical College, Stoke, under the chairmanship of Mr. F. Turner (president), states a report in the *Staffordshire Sentinel*.

An American manufacture of vitrified hotel ware, Mr. C. E. Jackson, of Wheeling, West Virginia, recently sent to Dr. J. W. Mellor, F.R.S., some fired examples of translucent ware which he described as the result of a desire to become familiar with some of the technical details connected with the manufacture of bone china. Dr. Mellor, on his visit to the United States, had seen some of the experiments that were being made by Mr. Jackson, but the work was then in an incomplete state, and Mr. Jackson promised that he would forward the result of the experiments later. These results, now to hand, formed the basis of an interesting discussion as to how far the use of American "Florida Clay" might enable the American potters to simulate the results obtained by the potters of Staffordshire using Cornish China Clay.

Americans Studying Bone China

Mr. Arthur Heath, who introduced the subject, said that there was no doubt that the Americans were seriously studying the production of bone china. Taken by itself, the work of Mr. Jackson might seem to be an isolated case of experimenting for a hobby, but to those who made a study of the American technical journals, the immense amount of work done on the subject of bone china must at once be apparent. He need only cite the exhaustive work of Mr. A. S. Watts, which covered twenty-six pages of the *Journal of the American Ceramic Society*, explanatory of some 500 trials.

But there was also the work of Mr. C. F. Binns, who in his "Plea for Bone China," said that "the final question and that which proves the practicability or otherwise of any enterprise is, will it pay? It is certain that the English potters make it pay and fill our finest stores with their high-class goods. It is also certain that domestic manufacturers can only capture this trade, or part of it, with goods of equally high-class quality. Bone china is a class by itself, and no other ware can successfully compete with it. . . . These arguments are advanced in the cause of bone china as the best means of meeting foreign competition. To attempt to make French or German porcelain would be to revolutionise every process in the factory, but as all American technique has been derived from England, it has been one step to take up and produce this beautiful ware."

China Clay and Stone Mixtures

Turning to deal with the samples to hand from Wheeling, Mr. Heath said that according to the formula submitted by Mr. Jackson in the original experiments the body consisted of practically 50 per cent. of calcined bone, 20 per cent. of Cornish Stone, and 30 per cent. of English China Clay. But Mr. Jackson found that a body of this type could not be handled by any American pottery, owing to the craftsmen not having been trained to handle any such type of body. According to Mr. Jackson's own admission, it would take years to complete the organisation so as to be capable of handling successfully a body of this particular type. Experiments were therefore made with the object of replacing the English China Clay with a clay of greater plasticity, and it was soon discovered that the Florida clay suited this purpose very well. Although a plastic clay, it did not tend to decrease the translucency in as great a measure as plastic clays generally; the refractory quality of the clay tended to prevent deformation, and gave a finer texture to the product, and the absorption was also increased. It was clear, therefore, that a mixture of English China Clay and Florida clay was more desirable from the point of view of working properties, and that a mixture of the two clays gave a more desirable product after firing.

Mr. Jackson had explained that a great many problems were encountered in doing the experimental work, and he could readily understand why a type of ceramic product such as bone china was not to be manufactured by all. The experiences gained had, however, justified the time and work expended.

Factors Influencing Microstructure of Porcelains

DIFFERENT investigators of the various factors influencing the microstructure of porcelain have found that the distribution of sillimanite crystals and the solution of quartz vary according to the conditions of firing. For instance, in one sample fired at cone 15 for an hour in a crucible furnace, the felspar melted entirely. Simultaneously, complete dissociation of the kaolin was accomplished, amorphous sillimanite being formed with an extremely small proportion of fine crystalline sillimanite. At the end of the hour solution of the quartz was trifling. After six firings, however, an increase in the amount of quartz to the extent of 15 to 30 per cent. was effected, the grains of this mineral being slowly rounded by solution. During experiments the temperature at which bodies matured was reduced by the presence of magnesia and lime; the finishing temperature being lower in the former sample than in those containing lime. When bodies containing these ingredients were fired at cone 11 (1,320° C.) they exhibited as great translucency as bodies fired at cone 14 (1,410° C.) containing felspar only. Both the lime and magnesia appeared to assist in the formation of sillimanite and in the reduction of quartz, this increased solution being due possibly to the diminished viscosity of the body.

The colour of the porcelains was in no way influenced by the admixture of a small percentage of dolomite. This mineral had the effect of reducing the temperature of vitrification in porcelains maturing between cones 9 and 11 (1,280° C. to 1,320° C.). Their toughness was increased by any addition of dolomite. A reduction in that property, however, was experienced with any increase in the percentage of whiting added to the mixtures. Such bodies were rendered more dense and vitreous. Porcelains made with a large proportion of dolomite were more crystalline in character, breaking with a coarse fracture. The formation of sillimanite and the solution of quartz were in no way retarded by the addition of increased proportions of dolomite. On the contrary, these operations appeared to progress well. Porcelains containing 0.3 per cent. whiting and dolomite gave an average compressive strength of 51,226 lb. per square inch. While the difference in compressive strength was insignificant between these ingredients, the greater strength was exhibited when whiting alone was used. The discrepancy in this quality being slight the recommendation is made that dolomite may beneficially replace whiting, since porcelains made with the admixture of dolomite withstand chipping better than those to which whiting has been added. Another advantage accruing from the use of dolomite is that it costs less than whiting.

Sands, Clays, and Minerals

OWING to the continued demand for it, Algernon Lewin Curtis, of the Westmoor Laboratory, Chatteris, has found it necessary to publish a fourth edition of his brochure on *Sands, Clays and Economic Minerals for all Industrial Purposes*. This useful little brochure gives valuable notes on a variety of products supplied by Mr. Curtis, including many varieties of sand (e.g., abrasive, aluminium casting, asphalt paving, asbestos, bottle glass, brass moulding, brick making, carborundum, cement, core, crucible, filtration, fire, furnace, glass, horticultural, monazite, polishing, quartz, sand blast, and silica sands, etc.); as well as on Ball Clays, barytes, bauxite, China Clays, corundum, kieselguhr, fire clays, fullers earth, graphite, mica, pumice, talc, zirconium, and many other products. The notes deal with the composition of the various substances, their uses, grading, etc., and should be of great interest to all who use these materials.

The Late Professor Patrick Carmody

THE late Professor Patrick Carmody, F.I.C., who died at Lostwithiel, on February 10, aged 76, had a very distinguished record. He had been a Fellow of the Institute of Chemistry for 41 years, having been elected in 1887. He was appointed Government Analyst and Professor of Chemistry at Trinidad in 1876, having entered the Government service 14 years earlier. Later on, in 1908, he became director of agriculture. Years earlier, he initiated instruction in agriculture in the elementary schools, and also lectures and demonstrations for the teachers. He retired on pension several years ago. Among his activities in Trinidad was welfare work for the poorer classes, and he was largely responsible for the erection of a group of model cottages for workmen.

"Rational" Analysis of Clays

By W. Singleton

[CONCLUDED FROM LAST MONTH]

THE following modification of Vesterberg's process (*Ark. Kemi Min. Geol.*, 9, 1 (1925)) is recommended for the examination of kaolin. One gram of clay is heated for one hour with 10 c.c. of 20 per cent. hydrochloric acid, and the undissolved portion is again subjected to the same treatment, part of it direct, and the remainder after heating to 800° C. The soluble alumina is determined in the hydrochloric acid solution and the soluble silica in the residue is extracted by boiling with 50 c.c. of a solution of 5 per cent. Na_2CO_3 and 0.5 per cent. sodium hydroxide, and 25 c.c. of 5 per cent. potassium hydroxide. The difference between the alumina and silica values obtained before and after heating gives the alumina and silica present as kaolin (they should be molecularly 1:2), and the kaolin is calculated by multiplying the alumina by 2.533.

Berdel's method for the rational analysis of clays may be modified to avoid certain sources of error, and to reduce the time taken for an analysis. The total silica is first removed by evaporating with sulphuric and hydrofluoric acids, the residue being dissolved in hot water and the alumina precipitated in the usual way. The filtrate is evaporated, dried and ignited, and its potassium oxide content determined, from which the felspar content of the clay is determined. After deducting the alumina of the felspar from the total alumina, the remainder will give the alumina content of the clay substance. The quartz is obtained by subtracting the total obtained from 100.

By these means the time taken for analysis is about a day and a half, whereas the Berdel method requires two or three days. Berdel's method, together with others, has been critically examined by Kall (*Keram. Rundschau*, 34, 58 (1926)). The method of Bollenbach gave incorrect values for the amounts of clay substance, quartz and felspar because of the presence of mineral impurities. The methods of Berdel, Backe and Kallauner-Matijka were tried on the same sample of kaolin and gave the following comparative results:—

Method.	Per cent. Clay Substance.	Quartz.	Felspar.
Berdel	92.6	6.6	0.9
Kallauner-Matijka	92.4	6.6	1.0
Backe	93.0	—	8.0

Backe's method is unreliable, but the methods of Berdel and Kallauner give useful results, preference being given to the Kallauner method, which is quicker and consistent. The principle of the Berdel method consists of the decomposition of the kaolin by sulphuric acid, whilst Kallauner uses heat and subsequent treatment with hydrochloric acid for the decomposition. The clay is heated to 800° C. for several hours, after which it is treated with hydrochloric acid to effect decomposition. The soluble alumina is determined by removing the small quantity of silica that dissolves and precipitating the alumina with ammonia. Steinbrecher (*Ber. Deut. Keram. Ges.*, 7, 321 (1926)) finds the solubility curve reaches a maximum at about 800° C. for most clays, and gives tables showing the chemical composition, mineralogical composition as calculated from the chemical composition, and the rational analysis of twelve clays. The results show that the rational analysis as determined by the Kallauner method agrees very well with the mineralogical composition.

Advantages of the Kallauner Method

According to Steinbrecher the silica which goes into solution on treating clays with hydrochloric acid for the precipitation of alumina as put forward in the Kallauner method cannot be neglected if serious errors are to be avoided. But Kopka and Zapp (*Keramos*, 5, 415, (1926)) state that as the method was not worked out on theoretical grounds but simply to serve the practical purpose of the control of raw materials, the silica remaining in solution by the Kallauner method may be neglected, as after treatment with hydrochloric acid at 105° C. it is less than 1 per cent. of the content of the clay substance. These authors have investigated the Berdel, Bollenbach, Kallauner, Schwalbe and Schmidt methods of rational analysis, special attention being given to the Kallauner method. They find the most suitable fusing temperature between 740° and 760° C., but the critical change point of 800° C. for kaolin must not be exceeded and the fusion continued not longer than two hours. They finally conclude

that the Kallauner method is more satisfactory than any of the other methods tried.

Vogt's method of rational analysis of clays depends upon two principal facts. First, that clay, kaolin and mica are dissolved by boiling sulphuric acid, whilst quartz and felspar are almost unattacked, and, secondly, that boiling caustic soda solution of specific gravity 1.8 attacks biotite but not muscovite. According to the method of Boudouard and Lefranc (*Bull. Soc. chim.*, 31, 1145, (1922)) a centesimal analysis is made and an analysis of the portion extracted by boiling sulphuric acid. From the figures thus obtained the kaolinite, muscovite, sand, water, and undetermined constituents are deduced.

Revival of West Country Porcelain

An Interesting Suggestion

A MORE prosperous Plymouth is the object of a movement by the local Mercantile Association, which has instructed its executive committee to go exhaustively into the question of possible industrial developments and to present a report thereon. Although the town is regarded as the West-Country metropolis it is woefully short of industries, and with an ever-increasing unemployed roll the necessity of action is being forced upon the town's public men. The proposal now under consideration is that 100 of the business leaders of Plymouth shall each contribute £100 to form a fund of £10,000 for the revival of an old industry or the starting of a new one.

It is generally thought that the industry most likely to yield encouraging results would be the revival of Plymouth porcelain, made famous by Cookworthy years ago. The raw material, China Clay, is on the spot, that found in the Dartmoor area being acknowledged to be the finest in the world. Cookworthy left Plymouth because of its distance from the fuel necessary for the firing of his pottery. The proposal to revive this industry is supported by Mr. S. G. Monk, head of the electrical engineering department at Devonport Technical College.

Porcelain for the Electrical Industry

Mr. Monk asks what better industry could be revived, seeing that the China Clay is on the spot, not for decorative purposes alone, but more especially for the electrical industry. He proceeds: "There is an increasing demand for high-grade porcelain for high voltage electrical work. The National Electricity Scheme has begun, the Central Scotland area being now developed and South-East England being the next. For this work alone a few million special grade insulators are required, and I believe that local China Clay is being used for this work, but not locally. The fact that Canadian firms see fit to advertise on the home market shows that there is a demand. Cookworthy left Plymouth ostensibly to get nearer to the fuel for firing. This excuse does not hold good to-day, because much better means of firing than the coke oven are available. Besides oil fuel, we have the best form of all now, and that is the use of the electric furnace. Temperature is under automatic control, and the consumption of energy is comparatively small, because there is no combustion and all the heat produced is utilised.

"Now, not only can we produce electrical energy as cheaply as elsewhere, but there is a fair amount of power available in Devon and Cornwall in small quantities. The installation at 'Bullaven' shows what can be done from a small stream, and there is plenty of power in that installation going to waste at night time to run quite a good-sized furnace. What better than to have a small unit in such a place, where the porcelain is moulded by day and fired under automatic control by night, and, better still, in larger units where more power is readily available all day long? The disadvantage of the Dartmoor hydro-electric possibilities is that the power is scattered in small units. Such an industry as above can work very advantageously in small units.

A Practical Suggestion

"Not being able to assist with cash, I am prepared to lend practical assistance. We are now installing in the Devonport Technical College an electric furnace, and I am sure the powers that be will not object to my carrying out trials on electrically fired porcelain to see what can be done with small units. I am fixing up with Mr. Clarke, of the Dartmoor China Clay Co., for the supply of the material, the local product being about the best in the world for porcelain work."

China Clay Notes and News

"Capt." Walter Light

THERE are few men better known among the clay workers of St. Austell China Clay district than "Capt." Walter Light. Though it is usual for captains of clay workers to be looked upon by the workers under them as masters' men, "Capt." Light, though he has occupied a "boss's" position for a great number of years with the firm now known as English China Clays, has always been and still is as much a "men's man" as a "master's man." He is by origin, upbringing, temperament and outlook a man of the people, and as such has always been the best friend of the China Clay workers, though at times, on account of the stand he has sometimes been compelled to take in their best interests, he has had hurled at him the epithets of "traitor" and "capitalist's tool."

Especially was this the case at the time of, and after, the disastrous clay strike of 1913, when he stood firm against the so-called friends of the clay workers. But by wise counsel and friendly intercourse he eventually convinced them of his sincerity as a champion of their best interests, and was instrumental, working behind the scenes, in securing for the clay workers concessions the extent of which only those "in the know" realised at the time or have realised since. As a level-headed, robust democrat he has always recognised and appreciated the indispensable part that capital plays in industry, to which it is as essential as labour. When the workers have been disposed to cavil at the part that capitalists must play in the development of industrial enterprises, Captain Light has oftentimes had to emphasise that labour, as well as capital, has its responsibilities and privileges.

Retiring from the Navy in 1891, he (a Devonian) settled in the St. Austell district in 1895 when he started work under the West of England China Clay Co. He proved himself to be a hefty and efficient worker at shifting sand and driving levels, until he was transferred to Drinnick shipping and loading sidings under old Captain Lillicrap. There he came under the appreciative notice of the late Mr. Tom Stocker, father of Mr. Medland Stocker, and when Captain Lillicrap died, was promoted to the position of shipping chief and became recognised as "Captain," a title given to managers in the clay works. When Captain Light was appointed, six loaders sufficed to cope with the work, but since then it has enormously increased, and Drinnick had become the chief loading centre in the St. Stephens area.

From Drinnick Captain Light progressed, and as becomes a naval man, has earned the title of "handyman" in the clay industry. There are few jobs on the clay works that Captain Light cannot take a hand in. His technical experience in the Navy has stood him in good stead as a civilian worker. Among many works of construction he has undertaken for his firm is the installation and erection of the company's whole system of private telegraphs and telephones, for the maintenance and repair of which he is responsible. A recent revelation of his capacity as a hustler was the repair of the damage done to the English China Clays, Ltd. offices by fire some time ago. The next day he had a gang of men on and in a few days had the roof restored.

St. Austell Coastal Developments

Compared with other parts of Cornwall, it must be confessed that St. Austell has somewhat lagged behind in the development of its coastal resources for the attraction of visitors and residents. There are prospects of a change in this respect, the foundations of which have already been laid by Mr. Walter Sessions in the opening up of Duporth Estate on the road to Porthpean beach and by Dr. Newcome Wright at Crinnis in connection with the development of Carlyon Bay Estate.

At Duporth Estate, Mr. Walter Sessions has made considerable progress by erecting a number of charming villa residences overlooking St. Austell Bay from the West. At Crinnis the development is on a somewhat more comprehensive and different scale. Already, thanks to the energy and enterprise of Dr. Newcome Wright, a flourishing golf links has been established adjacent to the coast and commanding magnificent views of St. Austell Bay from northwards. A road was cut and laid two or three years ago, and the estate has been planned for the erection of a number of first class residences,

bungalows, and houses, with the building of which a commencement has already been made.

On the other side of the road, a site with gardens adjoining has been mapped out for the erection of a commodious hotel with a hundred bedrooms on up-to-date lines. The plans for this hotel were approved at the last meeting of the Rural Council. The hotel will overlook Crinnis Beaches, and will be close to the Carlyon Bay Golf Links. It is intended that the hotel shall not only be the biggest in Cornwall, but the best equipped to meet the exacting needs of American and foreign tourists, many of whom visit the district in connection with China Clay business. The G.W.R. is behind the scheme.

Clay Worker's Compensation Money

His Honour Judge Gurdon at St. Austell County Court expressed his annoyance in caustic terms in the case of Joseph Henry Hick, of St. Dennis, who made application for the distribution of £175 paid into Court under the workmen's Compensation Act by the St. Dennis and Parkandillick China Clay Co. in respect of the death of his son, Howard Hick, on August 27, 1927. The application was for £50 down and 8s. per week.

Mr. Hick, the father of the young man, said he was 64 years of age, and his wife (who also appeared in Court) was 52. There were four children at home aged 15, 13, 11, 8. Two other daughters were in domestic situations and another was earning 15s. per week at a factory. The deceased lad's wages were £2 2s. per week, all of which he had handed over to his mother, and Mr. Hick himself earned on an average £2 2s. a week. The request for £50 was with the object of meeting funeral expenses and other debts. His Honour took strong exception to the statement of funeral expenses submitted to him. The total of £35 included a suit for the man, costume for his wife, clothes for the children, new shoes, and car hire for the funeral. The father explained that there were some other bills to come. The judge asked why they should go to that expense.

His Honour allowed the £50, instructing that the remaining £125 be invested, £1 2s. per month to be paid for the benefit of the applicants and the four daughters.

G.W.R. and Clay Traffic

Submitting the toast of the "G.W.R." at the annual dinner of the G.W.R. motor transport staff at St. Austell, Mr. J. W. Higman, who is joint managing director of Associated China Clays, Ltd., said no words of his were needed to commend to them the G.W.R. He had been connected more or less with the company for more years perhaps than he would like to mention. He had always found the officials and employees noted for being the most up-to-date and obliging of any he had met anywhere. So long as the G.W.R. existed that feeling would exist in many ways. He never felt more comfortable than when he was travelling on the G.W.R., though he had travelled abroad a good deal.

Responding, in the unavoidable absence of Mr. Robinson of Plymouth, Mr. Glasson, dock superintendent at Fowey, said if that toast meant anything it meant the spirit of loyalty, heartiness, and goodwill to the G.W.R. Co., in which most of their visitors were bound up. If that spirit was borne out through the coming time for their Bill, they would have something they had been wanting for a great number of years. There were many reasons why they should have that Bill passed. One reason was fair play, and they wanted to be fair and reasonable with other transport companies. Speaking of St. Austell's road motor transport Mr. Glasson said his experience was such that he believed that the transport department in St. Austell was second to none.

Touching upon the China Clay industry, Mr. Glasson said they were all interested in that. He paid a compliment to railway people throughout the China Clay area for the way in which they managed the business. He knew about it at Fowey, and the system they had built up after 40 or 50 years of experience merited the approval of the China Clay trade, which had proved that their present system was the best that could be adopted to ship clay as it should be shipped. It could not be done if all the men concerned were not loyal. Persons who sought to change that system undertook a very grave responsibility. Mr. Glasson said he felt sure that the trade would prosper.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay, with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—February, 1928

Arrived.	Name.	Sailed.	Destination.
February 4, s.s. <i>Brier Rose</i>	February 7, Runcorn		
February 4, s.s. <i>Lochaber</i>	February 7, Glasgow		
February 5, s.s. <i>Guelder Rose</i>	February 8, Runcorn		
February 6, s.s. <i>Uganda</i>	February 17, Philadelphia		
February 7, m.v. <i>Garth Avon</i>	February 9, Par		
February 8, s.s. <i>Seaforth</i>	February 9, Gravesend		
February 8, s.v. <i>W. E. Gladstone</i>	February 17, Plymouth		
February 9, s.s. <i>Abingdon</i>	February 11, Liverpool		
February 12, s.s. <i>Goole</i>	February 13, Gravesend		
February 13, s.s. <i>Hayle</i>	February 16, Larne		
February 14, s.s. <i>Pansy</i>	February 16, Leith		
February 14, s.s. <i>Foch Rose</i>	February 16, Brussels		
February 14, s.s. <i>Joffre Rose</i>	February 17, Antwerp		
February 17, s.s. <i>Gouwestroom</i>	February 21, Amsterdam		
February 17, s.s. <i>Scarho</i>	February 21, Hamburg		
February 18, s.s. <i>Sturdee Rose</i>	February 21, Weston Pt.		
February 18, s.s. <i>Neptun</i>	February 21, Genoa		
February 18, s.s. <i>River Lune</i>	February 20, Antwerp		
February 18, m.v. <i>Romanie</i>	February 22, Gijon		
February 18, s.s. <i>Clan Ross</i>	February 23, Bombay		
February 18, s.v. <i>Madeleine Tristram</i>	February 22, Charlestown		
February 19, m.v. <i>August Schierloh</i>	February 22, Aberdeen		
February 19, s.s. <i>Wild Rose</i>	February 24, Ghent		
February 21, s.v. <i>Ornen</i>	March 1, Fredrikshald		
February 21, s.s. <i>Primrose</i>	February 22, Preston		
February 21, s.v. <i>Montcalm</i>	February 22, Charlestown		
February 21, s.s. <i>Guelder Rose</i>	February 24, Antwerp		
February 22, s.s. <i>Teelsbridge</i>	February 25, Portland		
February 22, s.s. <i>Brynewel</i>	February 25, Rouen		
February 22, s.s. <i>Horn</i>	February 28, Bilbao		
February 24, s.s. <i>Ebbrix</i>	February 28, Rochester		
February 24, s.v. <i>Alert</i>	February 27, Charlestown		
February 24, m.v. <i>Dankward</i>	March 1, Bremen		
February 25, s.s. <i>Jellicoe Rose</i>	February 25, Fleetwood and Barrow		
February 25, s.s. <i>Bombardier</i>	February 29, Antwerp		
February 25, s.s. <i>Mersey</i>	March 1, Ritham		
February 25, s.s. <i>Hayle</i>	February 27, Preston		
February 26, s.s. <i>Brier Rose</i>	March 2, Weston Pt.		
February 26, s.s. <i>Ravenspoint</i>	February 29, Genoa		
February 27, s.s. <i>Blush Rose</i>	February 27, Bo'ness		
February 27, s.v. <i>Greenhithe</i>	* Greenhithe		
February 27, s.s. <i>Falconer</i>	March 2, Antwerp		
February 28, s.s. <i>Jolly Laura</i>	March 1, Tayport		
February 28, s.s. <i>Robrix</i>	March 1, Gravesend		
February 29, s.s. <i>Seaforth</i>	March 2, Rouen		
February 29, s.s. <i>Fairfield</i>	March 2, Grimsby		

* Signifies "In Port."

Charlestown Shipping—February, 1928

Sailings

DATE.	VESSEL.	DESTINATION.
February 2, s.s. <i>Christina</i>	Copenhagen
February 3, <i>Naiad</i>	Rochester
February 4, s.s. <i>Stanwell</i>	Leith
February 7, m.v. <i>Marhab</i>	London
February 11, m.v. <i>Joanna</i>	Berwick
February 14, s.s. <i>Freighter</i>	Gravesend
February 20, <i>Albatross</i>	Nantes
February 25, <i>Madeleine Tristram</i>	Nantes
February 25, s.s. <i>Knowlgrave</i>	Gravesend

Par Harbour Shipping—February, 1928

Arrivals

Date.	Vessel.	From
February 2, s.s. <i>Jarrix</i>	Plymouth
February 4, s.s. <i>Enterpriser</i>	Truro
February 8, m.v. <i>Garthavon</i>	Rochester
February 18, m.v. <i>Shamrock</i>	Plymouth
February 21, s.s. <i>Stanwell</i>	London
February 23, s.s. <i>Multistone</i>	Salcombe
February 24, s.s. <i>Magrix</i>	Hull
February 25, s.s. <i>Seaforth</i>	Goole

Sailings

Date.	Vessel.	Destination.
February 3, m.v. <i>Grit</i>	Rochester
February 4, s.v. <i>Lady Agnes</i>	Pentewan

February 7, s.s. <i>Jarrix</i>	.....	Antwerp
February 9, s.s. <i>Enterpriser</i>	.....	Rochester
February 22, m.v. <i>Shamrock</i>	.....	Plymouth
February 24, m.v. <i>Garthavon</i>	.....	Falmouth
February 25, s.s. <i>Multistone</i>	.....	Greenhithe
February 25, s.s. <i>Magrix</i>	.....	Truro
February 26, s.s. <i>Stanwell</i>	.....	Rouen
February 29, s.s. <i>Seaforth</i>	.....	Fowey

Par Harbour Tide Table, April, 1928

(Greenwich Mean Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Sunday	1	2.46	3.22	10.10
Monday	2	3.50	4.13	11.8
Tuesday	3	4.34	4.54	12.3
Wednesday	4	5.13	5.31	12.8
Thursday	5	5.47	6.2	12.10
Friday	6	6.17	6.32	12.11
Saturday	7	6.46	6.59	12.10
Sunday	8	7.13	7.27	12.6
Monday	9	7.41	7.55	12.0
Tuesday	10	8.9	8.24	11.5
Wednesday	11	8.40	8.58	10.8
Thursday	12	9.19	9.43	9.11
Friday	13	10.11	10.44	9.3
Saturday	14	11.23	—	9.0
Sunday	15	0.7	0.53	9.5
Monday	16	1.37	2.17	10.4
Tuesday	17	2.52	3.22	11.7
Wednesday	18	3.48	4.11	12.9
Thursday	19	4.32	4.52	13.7
Friday	20	5.13	5.35	14.2
Saturday	21	5.57	6.19	14.4
Sunday	22	6.41	7.2	14.4
Monday	23	7.22	7.43	13.9
Tuesday	24	8.5	8.27	12.11
Wednesday	25	8.50	9.15	11.9
Thursday	26	8.42	10.12	10.8
Friday	27	10.48	11.29	9.10
Saturday	28	—	0.15	9.7
Sunday	29	0.59	1.39	10.1
Monday	30	2.15	2.46	10.9

E. CLEMENS, Harbour Master.

China Clay Exports for February, 1928

A RETURN showing the quantities and values of the exports of Clay, China, including Cornish or China Stone, the produce of Great Britain and Northern Ireland, from Great Britain and Northern Ireland as registered in the month of February 1928, is as follows:

COUNTRY OF DESTINATION.	QUANTITY. Tons.	VALUE. £
Sweden	367	995
Norway	2	11
Poland	—	5
Germany	2,346	6,093
Netherlands	1,384	3,199
Belgium	3,851	8,542
France	1,309	2,997
Portugal	24	113
Spain	103	258
Italy	139	417
Bulgaria	4	35
Siam	5	28
China	5	18
United States of America	21,432	47,931
Mexico	250	1,012
Brazil	20	100
Argentina	10	68
Nigeria	—	1
Cape of Good Hope	—	3
Bombay, via Karachi	—	1
Bombay, via Other Ports	1,926	6,337
Bengal	55	238
Straits Settlements	2	27
Hong Kong	—	8
Australia	32	205
Total	33,260	78,642

February Deliveries Down

AFTER the rush experienced in the three previous months, the anticipated falling-off of demand in February was realised, though not to the extent that might have been expected. It is expected that it will take another month or two before the huge stocks taken in by buyers at 1927 prices have been absorbed. Now that the first effect of the 1928 programme has passed off, it is beginning to be realised by consumers that the increase in the prices of some clays is likely to make very little appreciable difference in the costs of production of the commodities in which China Clay is used.

The following are the details of February deliveries with comparisons with previous records—

Port.	CHINA CLAY.		CHINA STONE.		BALL CLAY.		TOTAL.	
	Tons.	1927.	Tons.	1927.	Tons.	1927.	Tons.	1927.
Falmouth...	150	130	—	—	—	—	150	130
Fowey.....	39,208	54,954	4,148	4,033	1,243	2,563	44,599	61,550
Par.....	1,477	4,858	137	—	—	—	1,614	4,854
Plymouth...	770	1,287	—	—	—	—	770	1,287
Charlestown	2,141	2,615	—	—	—	—	2,141	2,615
Penzance ..	434	1,190	—	—	—	—	434	1,190
By rail....	3,619	5,282	—	—	—	—	3,619	5,282
February ..	47,808	70,312	4,285	4,033	1,243	2,563	50,752	76,908
January ..	70,578	68,955	3,009	4,375	2,179	2,569	75,766	75,899
Two months	118,386	139,267	7,294	8,408	3,422	5,132	126,518	149,797

China Clay Imports for February, 1928

A RETURN showing the quantities and value of Clay, China, including China Stone, imported into Great Britain and Northern Ireland as registered in the month of February 1928.

COUNTRIES WHENCE CONSIGNED.	QUANTITY.		VALUE.
	Tons.		£
Germany	22		119
France	—		1
Czecho-Slovakia	—		4
U.S. America	28		160
Total	50		284

Hard Finish Gypsum Plasters

An American Investigation

THE University of Illinois Engineering Experiment Station has published a paper by T. N. McVay, entitled "A Study of Hard Finish Gypsum Plasters." This investigation was divided into two parts, the first dealing with the physical properties of hard finish plasters, and the second with a microscopic study of the setting of plasters. The first part deals with the effects of the additions of varying percentages of potash alum, Glauber's salt, and borax on the tensile strength, and rate of setting of gypsum calcined at different temperatures. Three methods were used in adding the salts. There is also included a brief study of the effects of curing commercial Keen's cement under different humidity conditions.

From this investigation it seems quite probable that plasters having high strength may be produced at a relatively low cost in commercial practice, and that their field of use may be extended. The greater strength of the plasters calcined at high temperatures, as compared with those calcined at low temperatures, is probably due to the more thorough crystallisation of the former and also the smaller amount of mixing water used, this producing plasters of greater hardness and density. Plasters of widely varying physical properties can be produced by treating gypsum with soluble sulphates before or after the final calcination; the former method causes the plasters to be more plastic.

Potash alum, on the whole, seems to produce more satisfactory results than Glauber's salt, but it is quite probable that other soluble salts may be as efficient as these. The physical properties of the plaster can also be controlled to a considerable degree by the temperature of calcination, assuming that the concentration of the soluble sulphates remains fixed. The higher the temperature of calcination (within the limits of this investigation) the slower are the reactions that take place in setting.

The second part is concerned with the progress of crystallisation and the kind and number of crystals produced. A theory for the mechanism of setting of these plasters is given. The rate of setting is correlated with the rate of crystal formation.

Safeguarding Granite

Cornish Quarry Owners' Views

AT the Board of Trade inquiry, recently, into the application by the Aberdeen Granite Manufacturers' Association for the imposition of a duty on imported manufactured granite, Mr. George McLeod, governing director of McLeod, Ltd., granite merchants and quarry owners, of Penryn, who gave evidence, said the Devon and Cornish granite trade had been in existence for at least a century. The total tonnage for Devon and Cornwall during 1927 was 18,300, and 1,200 men were employed, including quarrymen. Up to 1903 the whole of the demand for granite in the home market was supplied from home sources, and, in addition, a considerable amount of export trade was done. From 1919 to 1922 at least 80 per cent. of the granite work done in Devon and Cornwall was entirely monumental. In 1922 a big slump occurred. A revival took place about March, 1923, through the Government and various public bodies confining to home material the supply of granite used by them on such structures as the new bridge at Newcastle-on-Tyne, and the granite work for the Port of London extensions.

Swung Round

FOR the last four years the Devon and Cornwall granite trade had been maintained through securing these contracts, showing that the trade had completely swung round from monumental to be almost entirely depending for its existence on British granite being specified. But for that, there would be considerable unemployment. Foreign competition in the monumental trade had had the same effect on the manufacturers of Devon and Cornwall as it had had at Aberdeen.

Mr. W. Nankivell, senior partner of Wm. Nankivell and Sons, Bodmin, granite merchants and quarry owners, said he agreed with all that Mr. McLeod had said, which represented the views of the Cornish and Devonshire industry.

The inquiry was adjourned.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case, the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

ANGLO-FOREIGN PULP CO., LTD., London, E.C.—Registered January 30, £4,000 debentures, part of £60,000, charged on property known as Bayerische Zellstoffwerke, Regensburg, Germany, also general charge.

MITCHELL (THOMAS) AND SONS (GUILDFORD), LTD., brick and tile manufacturers.—Registered February 8, by order on terms, £3,800 debentures; general charge.

RICHARDSON (A. G.) AND CO., LTD., Burslem, earthenware manufacturers.—Registered February 6, £6,000 charge, to Mrs. S. L. Taylor, Bromley Lane, Congleton; charged on properties in Tunstall. *£12,500. October 2, 1927.

SKEGNESS BRICK AND TILE CO., LTD.—Registered February 13, £100 debentures, part of amount already registered; general charge. *£3,450. May 8, 1926.

ST. ANNES BRICK AND TILE CO., LTD., Blackpool.—Registered February 15, £5,000 debentures; general charge.

ST. LEONARDS TILE CO., LTD.—Registered January 27, £500 debentures; general charge. *Nil. July 14, 1927.

Satisfactions

BARKER BROTHERS, LTD., Longton, earthenware manufacturers.—Satisfaction registered February 15, £500, part of amount registered May 27, 1925.

HOWARD (WILLIAM) AND SON, LTD., Canterbury, paper manufacturers.—Satisfaction registered February 16, £15,000, registered February 14, 1913.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., Bouverie House, 154, Fleet Street, E.C.4. All communications relating to Advertisements, Subscriptions, etc., should be sent to the Manager, "The China Clay Trade Review," at this address. Telegrams—"Allangas, Fleet, London." Telephone—City 0244 (10 lines)

China Clay Publicity

RECENTLY some comment was made in the West of England Press on the absence of any trade representation by the China Clay industry at the British Industries Fair held in London in February. Inquiries made as to the reason why the industry did not avail itself of the opportunity afforded by the Fair, elicited the statement that the industry was not invited to exhibit. It was stated further that if the invitation had been made, the proposal would, of course, have been considered by the industry's representative organisation, which now functions as Associated China Clays, Ltd.; but, from the information then given, it was stated that had the industry received an official invitation, it was not at all certain that it would have even then made an exhibit.

Restricted Propaganda Outlook

ON this statement being further investigated, it was gathered that the view taken by China Clay producers is that the British Industries Fair is more an organisation for fostering markets in manufactured articles than a medium for fostering business of producers of raw materials. This view of the functions of the British Industries Fair has raised once again the question of the industry's attitude towards this and other methods of propaganda which are extensively used by other industries in this country, and by industries in other countries producing a raw material similar to that produced by the China Clay producers of Cornwall and Devon, and by producers of raw materials which are used wherever possible in substitution for China Clay.

We understand from the organisers of the British Industries Fair that this method of bringing to the notice of buyers the products of manufacturers and producers of raw material is in the interests of all to whom such an institution can be of service, in educating consumers as to the value of the article produced for certain commodities.

Wembley Example Not Repeated

AT the Wembley Exhibition an extremely interesting exhibit was made of China Clay, especially in directing attention to the value of China Clay in certain classes of chemical manufacture, and some articles were exhibited showing the excellence of manufactured articles in which China Clay was used. It might, perhaps, have been possible, at the recent British Industries Fair, for the China Clay industry to have staged an equally interesting and profitable exhibition, by bringing together in one collection the numerous articles and commodities in which China Clay is used, and emphasising the superiority of the product of the West Country in those classes of manufacture.

U.S.A. "Boosting" Contrast

WHEN the question of extended publicity is advocated for emphasising the constituents of China Clay and their advantage over other raw materials in manufactured goods, the comment is often made that China Clay is sufficiently well-known without such aids to publicity. This attitude affords a very striking contrast to the attitude taken by competitors of British China Clay in other countries, especially in the United States of America, where a very

active propaganda has been going on for several years, not only by producers of domestic clays, but by Government Departments, who have made and who continue to make very detailed investigations into the extent and quality of their clay deposits. So complete is the propaganda service undertaken by the trade organisations and Government Bureaux in the United States, that books have been published from time to time giving the most complete information as to the usefulness of the various qualities of China Clay produced, for circulation among manufacturers who have been in the habit of using imported clays.

Propaganda Pays

IN addition to the impetus given to the development of domestic clays in America by the war more particularly and, in a lesser degree, by labour disputes in this country, there is no doubt that the propaganda referred to has proved a great factor in the expansion of the domestic China Clay industry in the States. The China Clay industry of Cornwall and Devon is undertaking nothing comparable in publicity with the publicity undertaken by the American producers of China Clay and their Government Departments. It certainly raises the question as to whether the China Clay industry in this country is doing sufficient in the way of propaganda, not only to emphasise the superiority of its product in the United States markets, but to show also how it is superior in directions in which attempts are being made by American producers to substitute their product.

Associated Producers' Opportunity

IN the absence of a central organisation during the last two or three years, there is some excuse for the absence of united propaganda for the "boosting" of British China Clays, but now that a new organisation has been set up that embraces practically the whole of the industry, it ought to face seriously this question of intensive propaganda such as is going on in the United States of America, if the products of the industry are not only to hold their own, but to increase in volume of sales at least in the same ratio as the sales of domestic China Clays are increasing in the States. As we pointed out last month, there is no doubt as to the superiority of British China Clays, and it only remains for these superior qualities to be made known for this raw material to be used more extensively than ever.

A Local Exhibition

THOUGH the exhibition may not afford such scope as more national displays, it is to be hoped that the industry will co-operate with the Royal Cornwall Polytechnic Society in its next exhibition, which is to be held at St. Austell in July. This society was instituted in 1833 for the objects of encouraging scientific, mechanical, fine and industrial arts and education, and generally to promote the best interests of the county by fostering all inventions that tend to the improvement and prosperity of its industries.

St. Austell being the centre of the China Clay and Stone works, it has been decided that exhibits connected with this important industry shall be one of the chief features of the forthcoming exhibition.

The Characterisation of Clay

An Account of Some Recent Research

For some time past, Dr. A. F. Joseph, the Sudan Government Chemist, has been engaged in investigations on clay. His work deals with heavy soils containing 50 per cent. or more of clay, and for comparison with a considerable number of samples of China Clay. Some of the results of the work are described below.

In a paper read before the Clay Convention, Dr. A. F. Joseph pointed out that the investigations on the nature of clay, carried out by soil workers during the last five or six years, were worthy of more attention than appeared to have been paid to them by their colleagues in the ceramic industry. It would, indeed, be greatly to the advantage of investigators in both fields of activity if regular or occasional opportunities could be found for joint action and discussion.

Mechanical Composition of Clays

One of the difficulties in passing from the work of soils to that on ceramic clays was the absence of a common definition of "clay." Most (but not all) soil chemists restricted this term to that fraction of the raw material of which the largest particles were 0.002 mm. It was fairly certain that the real clay-like properties of importance, such as plasticity, shrinkage, and water-retaining capacity, were mainly confined to that fraction, and there was an obvious advantage in studying materials which were as homogeneous as possible. An illustration would show the important differences which existed between fine and coarse fractions.

Mechanical analysis of a red soil from Kordofan showed that 67 per cent. consisted of particles smaller than 0.2 mm., but only 29 per cent. smaller than 0.002 mm.; the larger fraction contained 70 per cent. of silica, but the smaller one only 42 per cent. Now it was obviously useless to try to connect the clay-like properties of the 0.2 mm. fraction with its composition, because it contains a large proportion of coarse material from which these properties are altogether absent. The point might be perhaps further illustrated by comparing these figures with the composition of a very highly plastic bentonite containing 68 per cent. silica. This would suggest an analogy in composition with the Kordofan coarse material which was altogether false, the facts being that whilst bentonite was comparatively homogeneous, the Kordofan soil contained about 30 per cent. of fine quartz in addition to the clay proper.

Mechanical Analysis

In the examination of a clay, it was therefore essential to determine the proportion of the fractions of different-sized particles, and to study in detail, at any rate, the finest ones. The mechanical analysis was conveniently performed by the sedimentation method in common use for the examination of soils, 0.05 per cent. solution of sodium carbonate being used to facilitate dispersion. If a considerable quantity of the "clay" fraction was required for further examination, this was obtained in the same way, the bulky dilute suspensions being flocculated by a trace of acid, and the resulting precipitate purified by dialysis until the specific resistance (30,000-130,000 ohms) showed that the desired degree of purification had been obtained.

The following table showed the range in mechanical composition for a dozen samples of ceramic clays:—

Per cent. of particles less than	Mechanical composition.		Sample No.
	0.002 mm.	0.02-0.002 mm.	
20.2	5.5	74.2	10,056
36.6	2.6	60.8	10,057
28.2	10.1	61.7	10,095
26.3	9.9	63.8	10,096
12.8	14.7	72.5	10,118
31.8	7.2	61.0	10,119
89.8	3.9	6.3	10,120
60.9	24.0	16.9	10,121
63.2	27.1	8.3	10,122
28.0	6.4	65.6	10,123
26.8	9.4	63.8	10,124
20.4	3.7	65.9	10,125

The range in the proportion of true "clay" (less than 0.002 mm.) was considerable, varying from 12 to 90 per cent., and if the nature of this fine fraction did not vary in materials of different origin, the properties of the whole product would

probably depend on the amount of the 0.002 separate (i.e., the "clay"). For example, the fine fractions of Nos. 10,118 and 10,119 were not very different in their properties or composition, so that No. 10,119, containing 2.5 times as much "clay" as 10,118, should be more plastic, and this was actually the report of the makers. On the other hand, although Nos. 10,095 and 10,096 closely resembled one another in mechanical composition, the former was very much more plastic than the latter, so that the reason must be sought in the nature and not in the amount of the "clay" fraction.

Chemical Composition of Clays

The illustration given previously showed the uselessness of attempting to correlate properties with chemical composition unless fairly homogeneous fractions of similar particle size were used. This was now recognised fully in soil chemistry, and much work had been done on the finest portions of the soil separated either by sedimentation or by the use of the Sharples's super-centrifuge. These results had shown conclusively that there was a very close relationship between the chemical composition of the "clay" and its physical properties which could be generalised by the statement that the molecular ratio of silica to alumina was related to clay-like properties. The higher this ratio was, the more highly developed were such properties as imbibitional power for water, heat of wetting, shrinkage, tensile strength and absorptive power for vapours and dyes; with low values of this ratio, clay-like properties were exhibited to only a small degree, and it appeared likely that with a ratio of 2.0 (the ratio for kaolinite $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$) they would be entirely absent. It had been so commonly assumed that the ideal "clay substance" was some form of kaolinite (or at least had the same chemical composition), that this idea of plasticity being connected with a relatively high silica content was somewhat novel, but the overwhelming body of evidence now obtained placed it beyond doubt.

At present, no method existed of adequately measuring plasticity in the laboratory; the physical properties above mentioned were usually connected with it, but exceptions occurred with them all, and further investigation was needed before any of them could be considered the best as an index of plasticity. Dr. Joseph preferred the "imbibitional water" capacity for this purpose. This was a measure of the volume of water retained by the material after centrifugal draining under standard conditions less the interstitial space, the latter being measured by the volume of some inactive liquid (xylene was very suitable) retained under the same conditions. A "moisture equivalent" centrifuge was used for the determination, and by its means the clay was subjected to a draining force 1,000 times that of gravity for 40 min.; the percentage of liquid retained was estimated by loss of weight on drying in the usual way, the results being expressed on a volume basis, i.e., the volume of liquid associated with 100 c.c. of dry clay.

The following figures gave the abbreviated chemical composition and imbibitional water capacity of six "clay" separates, together with three typical "clays" of different origin:—

No. of original material.	Properties of Clay Fraction.			Ratio $\text{SiO}_2/\text{Al}_2\text{O}_3$	Imbibitional water.	Description.
	P.c. SiO_2	Al_2O_3	P.c. $\text{Na}_2\text{O} + \text{K}_2\text{O}$			
10,096	46.6	38.5	0.90	2.05	0	Weak clay.
10,123	47.0	38.7	1.20	2.06	0	Potting clay.
10,118	46.8	37.6	0.88	2.11	5	Weak clay.
10,119	47.8	37.3	1.07	2.18	7	"
10,095	47.6	36.3	2.16	2.23	19	Strong clay.
10,120	49.3	31.4	1.12	2.66	44	Ball clay.
8,320	44.6	20.0	1.53	3.77	79	Alluvial soil.
6,640	46.7	20.2	1.02	3.90	101	Plastic soil.
10,743	68.3	16.6	1.66	6.96	261	Bentonite.

The list could be greatly extended for soil clays, but the above figures were sufficient to show clearly that clay properties were associated with a high silica-alumina ratio, and that the materials whose composition approximated to that of kaolinite were hardly worthy of being called clay at all.

Colloidal Clay

It had in the past been commonly assumed that clays contained a small proportion of extremely fine material to which their characteristic properties were due, high and low plasticity being associated with a larger or smaller proportion of this substance. This could no longer be held to be the case, as all plastic "clays" (and some of weak plasticity) could be obtained in the form of very fine material. This had been shown in Dr. Joseph's laboratory by passing a thin clay suspension through a Sharples' super-centrifuge, a very dilute suspension of "colloidal clay" being separated. If now the residue left in the centrifuge was shaken with more water and the process repeated a further quantity of "colloid clay" was obtained: in one trial, 50 centrifuge runs were made with the same specimen, additional quantities of colloid being obtained each time. Owing to the nature of the apparatus, experiments could not be carried out quantitatively, but the indications are that the whole of the original 0.002 mm. fraction was obtainable in the colloid form. Much remained to be done in the way of subdividing the fraction of clay into finer fractions, but it was almost certain that the 0.002 mm. fraction of a plastic material consists of particles fine enough to be considered "colloidal," and that the colloid content of a raw material might be taken as identical with its "clay" content.

The work of American investigators had shown that a relation similar to that found for "clay" existed between the chemical composition of these colloid fractions and their physical properties. They used the molecular ratio of silica to alumina + iron oxide as an index of the composition, but there was a close correlation between that and the simpler ratio of silica to alumina.

Institute of Mining and Metallurgy

Visit to be Made to Cornwall

It was reported at a meeting of the Cornish Institute of Engineers, at Camborne, on Saturday, April 14, that arrangements had been definitely made for the visit to Cornwall in May of the Institution of Mining and Metallurgy, which it is interesting to note will be the Institution's first formal meeting away from London. The visit should prove extremely valuable to the Institution itself, as it will explore the most important non-ferrous mining district in England, and it will also be of great importance to Cornwall as an opportunity of exhibiting local resources and possibilities. In extending the invitation, the Cornish Institute of Engineers secured the support of the Cornwall Chamber of Mines, the Royal Geological Society of Cornwall, the Royal Cornwall Polytechnic Society, and the Royal Institution of Cornwall as joint hosts, and the combined resources of these five organisations should be a guarantee of a programme which will be memorable in the history of the visiting Institution.

Captain William Thomas, joint secretary of the Cornish Institute of Engineers, intimates that the following attractive programme has been arranged. On Tuesday, May 22, the visitors will be received in the Lecture Hall of the Camborne School of Mines at 10.30 a.m. The meeting will last about an hour and a half, and short papers will be read by the managers of East Pool and Agar, South Crofty, and Dolcoath Mines, in which the main points of interest will be laid before the visitors prior to their visits to the places. Holman Bros., Ltd. have invited the whole party to luncheon and to spend two or three hours at their engineering works. The visitors will proceed to Messrs. Bickford Smith and Co.'s fuse factory at Tuckingmill, where a tour will be made and tea served. In the evening the visitors will be the guests of the five institutions at dinner at the Commercial Hotel, Camborne. The president of the Royal Institution of Cornwall will preside. On Wednesday, May 23, the party will meet at South Crofty Mines at 10.30 a.m., and remain to luncheon by the invitation of the directors. It will then proceed to East Pool Mine, where it will be entertained to tea. On Thursday, May 24, the party will assemble at Dolcoath Mine, and spend the afternoon in the China Clay works.

It is stated that so far over seventy members, including the retiring president, the president-elect, and several members of the council, have intimated their intention of making the journey to Cornwall, and the party will also include about twenty ladies.

Obituary

Mr. William Wedlake

THE sudden death last month of Mr. William Wedlake, of Mt. Charles, St. Austell, came as a great shock to his family and friends. In the bitter wintry weather after Christmas Mr. Wedlake caught a chill which necessitated his staying indoors for a week or two. He made a good recovery, but ventured out too soon and had a relapse. He was making such good progress to complete recovery that his doctor had promised that if the improvement continued he would be able to resume his business the following week. One evening, after attending to various matters connected with China Clay, he was sitting in his armchair by the fire with members of his family, and while Mrs. Wedlake was out of the room for a few minutes, he lay back in his chair and passed away without any warning.

Mr. Wedlake was 64 years of age, and leaves a widow, two daughters, and a daughter-in-law (the widow of his only son Dick, whose death eighteen months ago was a great blow to him), as well as his mother, for whom great sympathy is felt.

Mr. Wedlake was one of nature's gentlemen. As a lad, at an age when boys nowadays are still at school, he went to work in the tin mines in the locality at Holmbush, where he was born, and where his mother, aged 84, still lives. After reaching man's estate, he felt the handicap of lack of education so much that he went to Mr. Ray's School in South Street, and acquired by industry and study the knowledge which he put to such good purpose in after life. As a young man he emigrated to South Africa, and as under-manager in the famous Van Ryan Deep gold mines he was able, by a process of geological deduction, to direct work in a direction which led to the discovery of a lode of enormous value. Returning to this country about thirty years ago, he interested himself in China Clay mining. A notable mining achievement of his was the cutting of the underground adit from J. Lovering and Co.'s China Clay pit at Carclaze over a mile in length. He opened up, planned, and laid out the St. Austell China Clay works in the Gover Valley.

He was all his life a worker, and was a striking example of a man grappling with his environment, mastering it, and making it the stepping-stone of his success. He was always anxious to see the China Clay industry as a whole successful, and to this end laboured assiduously to keep in being the old association, and threw all his weight in favour of the movement for a new association which was successfully accomplished last year. He was a reliable and valued member of the board of Associated China Clays, Ltd.

Mr. W. J. Kelly

The death occurred at St. Austell on April 16th, at his residence, Fernleigh, Alexandra Road, of Mr. W. J. Kelly, at the age of 78. He was responsible for the introduction of a good many China Clay properties for development by company promoters and retained a financial interest in several China Clay works.

Moisture in Clay

In a recent number of the *Bulletin of the Institute of Physical and Chemical Research* of Tokyo (Vol. 7, No. 2, pp. 199-236, February), T. Okazawa, in a paper entitled "Studies on Clay. X. On the Moisture of Clay," tries to give a new explanation of the nature of so-called moisture or mechanically combined water, also called adsorbed water, in clay. In contradistinction with the conceptions involved in these various descriptions, he chooses to conceive the moisture to be water entering into certain chemical combination besides the recognised constitution of clay. Stress is laid upon the *raison d'être* of the existence of an inflexion point in every isotherm of several sorts of clay.

Canadian Imports and Exports of China Clay

THE *Preliminary Report on the Mineral Production of Canada* for 1927 indicates that imports of China Clay into Canada that year totalled 420,822 cwt., valued at \$235,824, as compared with an import of 360,546 cwt., valued at \$200,902, in 1926. In 1927, for the first time since 1923, a production of kaolin was reported in Canada, 24 tons of kaolin being shipped from the St. Remi d'Amherst deposit in Quebec.

China Clay Notes and News

Truro Harbour Order

TRURO Chamber of Commerce have lodged an objection against the proposed new Harbour Order which Truro City Council are seeking to obtain. At the annual meeting of the Chamber, Mr. H. Rosewarne presiding, it was considered that the construction of a new straight channel from Newham to Lower Newham was unnecessary. It is from Newham that China Clay is shipped.

A sub-committee appointed to consider the proposed improvements to Truro River and the City Council's application for a new Provisional Order reported having sent an objection to the Ministry of Transport with the signatures of merchants who were the principal users of the port. The grounds for objection were that the construction of a new straight channel from Newham to Lower Newham was not necessary, and would entail unnecessary expense in construction and maintenance. They were in agreement with the necessity for improving the existing navigable channel from Truro Quay to Sunny Corner by widening and straightening the channel and deepening the harbour by dredging; but they did not consider a 100 per cent. increase of dues necessary to finance the improvements of the river, being strongly of the opinion that the engineer's estimate of first cost and working expenses was excessive.

Port Isaac Harbour

The Minister of Agriculture and Fisheries, Mr. Walter Guinness, speaking in the House of Commons on the Supply Vote for the Fishing Industry, stated that work was about to be commenced on the improvement of Port Isaac harbour. He said the harbour had been a very difficult problem ever since he had been at the Ministry, and he was glad that a solution had been reached at last. The Government were finding £22,000 towards the cost of the works, and the locality was finding £11,000, of which Cornwall County Council were providing £2,000 and Bodmin Rural District Council £5,000. The balance has been found by private subscribers. When the scheme is completed, it is expected that the harbour will also be used for China Clay traffic.

St. Austell Rates 8s. 6d. in the Pound

In submitting the Finance Committee's report recommending a poor rate (which includes the county rate) of 4s., a general district rate of 3s. 10d., and a water rate of 8d. for the ensuing half-year, Councillor Hubbard pointed out at the St. Austell U.D.C. meeting that the poor rate this time was 4s. against 3s. 8d. last time, an increase of 4d. It was only fair to say that over that rate the Council had no control, being in the position of a collecting authority. St. Austell Union was responsible for an increase of 2d. and the County Council for 2½d. In order that the total rate on St. Austell ratepayers should not be increased they were able to reduce the general district rate by 2d. and the water rate by 2d., thus counteracting the effect of the 4d. poor rate increase. If the County Council and Guardians had been actuated by the same desire for economy as the Urban Council, the candidates would have been able to go to the electors with a very fine election speech. They were entitled to say that they had done their part and were not to blame for those over them.

Ex-China Clay Manager Elected Councillor

Mr. R. M. Richards, who hails from Bugle, and has spent all his life in various capacities in the China Clay industry, began his business career as a worker in the China Clay pits, and made such progress that he gained a responsible position in the industry. For many years he was works superintendent at the North Cornwall China Clay works, until his appointment in a similar capacity with Cornish Kaolin, Ltd., several years ago, when he came to live at St. Austell. He has recently retired from the position and is now devoting his leisure to public work. He was a member of the St. Breward Council when he was engaged in North Cornwall, and has now been elected to the St. Austell U.D.C. He has undertaken housing, road-making, water and drainage schemes in connection with China Clay works, which he claims qualifies him to become an efficient councillor.

Presentation to Quarry Manager

An interesting event occurred at the Tresarret Quarry, Blisland, near Bodmin, when the quarry workers presented Capt. R. W. Williamson with a gold-mounted fountain pen and a similarly mounted pencil on his leaving the quarry. Mr. H. Symons, in making the presentation, said that Capt. Williamson had not only done his best for the company but had always considered and helped the men. Capt. Williamson, in returning thanks, expressed his regret at leaving the men who had worked so loyally with him.

Healthy China Clay Work

Recently, in the House of Commons, Mr. Kelly asked the Secretary for Mines if he had had any reports from his officers as to the conditions of the China Clay industry in Cornwall, and particularly the effect on the health of the workpeople. Mr. Herbert Williams (Parliamentary Secretary to the Board of Trade) replied that the reports of H.M. Inspector of Mines stationed in Cornwall indicated that the health conditions of the mines were good and that no case of disease due to the conditions of employment had come to his notice.

Mr. Kelly also asked the output of the tin mines of Cornwall for 1919, 1920, and 1927. Mr. Williams replied that output of dressed tin ore from the mines in Cornwall was 4,454 tons in 1919, 4,123 in 1920, and 3,694 in 1927. In the same years 674, 709, and 454 tons of dressed ore were produced from other workings.

Afghan Minister's Cornish Connections

At the centre of the organisation that has made possible the breathless bustle of the King of Afghanistan's stay in this country stands the British Minister at Kabul, upon whom a G.C.V.O. has now been conferred. The career of Lieut.-Col. Sir Francis Humphrys, eldest son of the Rev. W. Humphrys, who some years ago was rector of Helland, Bodmin, began in the Indian Army. Intimately acquainted with the North-West Frontier since the early part of the century, having been personal secretary to the First Commissioner of the frontier province and Assistant Commissioner in various places, he became Political Agent of Tochi early in the war, was Political Officer with the Waziristan field force, and also held a commission in the R.A.F. He was political agent of the Kyber from 1919 to 1922, in which year his appointment to his present position was made. Anyone meeting him for the first time would know him to be a soldier, and contact with his tireless brain brings instant realisation of his ability in matters of organisation and administration. Sir Francis is a brother-in-law of Mr. Walter Graham (who is secretary of the China Clay Owners Federation, Ltd., St. Austell, and a partner of the firm of solicitors of Stephens, Graham, Wright and Co.), and a brother of Mr. Noel Humphrys, who lives with his mother at Elmsleigh, Tywardreath.

Public Recognition of St. Austell Journalist's Services

At the last meeting of the St. Austell Urban District Council, Councillor F. W. Mutton, J.P. (the chairman) said it was a very pleasant duty which came to him as his share of that evening's enjoyment, which would be shared by the vice-chairman (Councillor Williams), in the presentation to Mr. S. P. Bunn of a framed painting by Mr. Baragwanath King, a Cornish artist, on behalf of the council, in recognition of the courteous, kindly, and successful way in which he had reported the proceedings of that and other councils for a period of 25 years. It was a recognition by the council of his interest in and his kindly reporting of the work of the council of that area. The interest and advantages that came to the district through the kindly disposition of Mr. Bunn towards them were considerable, for he stood in a position of great responsibility in which he could exercise his influence in emphasising the importance and interests of the town and district.

Mr. Bunn, in addition to being the local manager of the *Cornish Guardian* newspaper, is well known in the China Clay industry as a trade journalist who has furthered the interests of the industry in a variety of ways. He has long been a valued contributor to THE CHINA CLAY TRADE REVIEW.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay, with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—March, 1928

Arrived.	Name.	Sailed.	Destination.
March 1,	s.s. <i>Suffolk Coast</i>	March 2,	Liverpool
March 1,	s.s. <i>Otto Fischer</i>	March 3,	Karlskrona
March 1,	s.v. <i>Galathea</i>	March 10,	Sandviken
March 1,	s.s. <i>Reedness</i>	March 3,	Par
March 2,	m.v. <i>Lydia Cardell</i>	March 22,	Antwerp
March 2,	s.v. <i>Yealm</i>	March 10,	Pentewan
March 3,	s.s. <i>Jolly Marie</i>	March 6,	Charlestown
March 3,	s.s. <i>Gouwestroom</i>	March 6,	Amsterdam
March 3,	m.v. <i>Mayblossom</i>	March 10,	Pentewan
March 3,	s.v. <i>Flying Foam</i>	March 24,	Rochester
March 3,	s.v. <i>Clympeing</i>	March 24,	Dunkirk
March 4,	s.s. <i>Rhea</i>	March 6,	Helsingfors
March 5,	s.s. <i>Jellicoe Rose</i>	March 6,	Runcorn
March 5,	s.s. <i>Bracondale</i>	March 9,	Portland, Me.
March 5,	s.v. <i>Norden</i>	March 8,	Göthenburg
March 6,	s.s. <i>Sturdee Rose</i>	March 8,	Preston
March 6,	s.v. <i>Isabella</i>	March 24,	Goole
March 6,	s.s. <i>Mersey</i>	March 8,	Rouen
March 7,	s.v. <i>Waterwitch</i>	April 4,	Runcorn
March 7,	s.s. <i>Haig Rose</i>	March 10,	Brussels
March 9,	s.s. <i>Walnut</i>	March 14,	Fleetwood
March 9,	s.s. <i>Torfrid</i>	March 14,	Odense
March 9,	m.v. <i>Johanna</i>	March 18,	Dundee
March 9,	s.v. <i>Sidney</i>	March 22,	Plymouth
March 10,	s.s. <i>Knowlgrave</i>	March 13,	Gravesend
March 10,	s.s. <i>Italy Maru</i>	March 17,	Boston and Portland, Me.

March 10,	s.s. <i>Primrose</i>	March 12,	Rouen
March 10,	s.s. <i>Hayle</i>	March 15,	Manchester
March 11,	s.s. <i>Brier Rose</i>	March 17,	Garston
March 11,	s.s. <i>Mington</i>	March 16,	Harburg
March 12,	s.s. <i>Pylades</i>	March 14,	Methil
March 12,	s.s. <i>Tanny</i>	March 15,	Bristol
March 13,	s.s. <i>Wearbridge</i>	March 22,	New York
March 13,	m.v. <i>Amazon</i>	March 14,	Torquay
March 13,	s.s. <i>Farfield</i>	March 15,	Grimby
March 14,	s.s. <i>Christiana</i>	March 16,	Liverpool
March 14,	s.s. <i>Wild Rose</i>	March 22,	Weston Point
March 14,	s.s. <i>Blush Rose</i>	March 17,	Bo'ness
March 14,	s.s. <i>Exeter City</i>	March 23,	Norfolk, Va.
March 14,	s.s. <i>Carham</i>	March 20,	Antwerp
March 15,	s.s. <i>Chloris</i>	March 20,	Hamburg
March 16,	s.s. <i>Guelder Rose</i>	March 22,	Antwerp
March 17,	s.s. <i>Joffe Rose</i>	March 22,	Preston
March 18,	s.s. <i>Horn</i>	March 24,	La Pallice
March 18,	s.v. <i>Flora</i>	March 20,	Munkedal
March 19,	s.s. <i>Hartbridge</i>	March 31,	Portland, Me.
March 20,	s.v. <i>Raymond</i>	April 2,	Briton Ferry
March 21,	s.s. <i>Rayford</i>	March 23,	Aberdeen
March 22,	s.s. <i>Mersey</i>	March 27,	Ridham
March 22,	m.v. <i>Eurasia</i>	March 27,	Dutch Guiana
March 22,	m.v. <i>Waldemar Tornoe</i>	March 26,	Harburg
March 22,	s.s. <i>Gouwestroom</i>	March 24,	Amsterdam
March 22,	s.v. <i>Mary Ann</i>	March 28,	Garston
March 22,	s.v. <i>La Poilu</i>	March 27,	Lizardreaux
March 24,	s.s. <i>Creek Fisher</i>	March 28,	Antwerp
March 25,	s.s. <i>Stanwell</i>	March 30,	Tayport
March 25,	s.s. <i>Nautik</i>	March 28,	Genoa
March 25,	s.s. <i>Primrose</i>	March 30,	Larne
March 26,	s.v. <i>Merkur</i>	April 2,	Copenhagen
March 26,	s.v. <i>Sigrid</i>	April 1,	Aarhus
March 26,	s.v. <i>Solon</i>	March 29,	Drammen
March 27,	s.s. <i>Southwell</i>	March 31,	Passages
March 27,	s.s. <i>Levenbridge</i>	April 4,	Philadelphia
March 27,	s.v. <i>Emily Warbrick</i>	April 2,	Weston Pt.
March 27,	s.s. <i>Pansy</i>	March 30,	Runcorn
March 27,	s.s. <i>Farfield</i>	March 31,	Hull
March 28,	s.s. <i>Stav</i>	March 31,	Weston Pt.
March 31,	s.s. <i>Joffe Rose</i>	April 3,	Brussels
March 31,	s.s. <i>Blush Rose</i>	April 3,	Runcorn
March 31,	s.s. <i>Mons</i>	April 4,	Antwerp

Penzance Shipping—March, 1928

Arrived.	Name.	Sailed.	Destination.
February 27,	s.v. <i>Mary Barrow</i> (of Barrow, from Rochester)	March 13,	Rochester
March 26,	s.v. <i>J. Milton</i> (of Bridgwater, from Falmouth)	March 30,	Ridham
March 31,	s.s. <i>Pansy</i> (of Liverpool, from Fowey)	March 31,	Runcorn

Charlestown Shipping—March, 1928

Date.	Vessel.	Destination.
March 2,	s.s. <i>Magrix</i>	London
March 5,	s.s. <i>Treleigh</i>	Preston
March 6,	s.s. <i>Ivy</i>	Thames
March 6,	s.s. <i>Cathrine</i>	Copenhagen
March 7,	s.s. <i>Durstone</i>	London
March 7,	s.s. <i>Jolly Marie</i>	London
March 8,	m.v. <i>Markab</i>	London
March 9,	s.s. <i>T. W. Stewart</i>	London
March 13,	<i>Lady Daphne</i>	Snodland
March 16,	<i>Irish Minstrel</i>	Rochester
March 16,	<i>B. 25</i>	Nantes
March 16,	<i>Pet</i>	Runcorn
March 20,	<i>Trevellas</i>	Mersey
March 22,	<i>Tarragonna</i>	Rochester
March 22,	<i>Daisy</i>	Runcorn
March 23,	s.s. <i>Trader</i>	London
March 26,	s.s. <i>Robrix</i>	Gravesend
March 27,	<i>Elsa</i>	Nantes
March 28,	<i>Rothersands</i>	London
March 29,	<i>John Sims</i>	London
March 31,	<i>Two Sisters</i>	London

Par Harbour Shipping—March, 1928

Arrivals		
Date.	Vessel.	From
March 1,	m.v. <i>Isabel</i>	Penzance
March 1,	s.s. <i>Enterpriser</i>	Truro
March 3,	s.s. <i>Reedness</i>	Blyth
March 3,	s.v. <i>Lady Jean</i>	Plymouth
March 3,	s.v. <i>Snowflake</i>	Mevagissey
March 4,	s.v. <i>Will Everard</i>	Portsmouth
March 4,	s.v. <i>Naiad</i>	Truro
March 6,	s.s. <i>Lynher</i>	Plymouth
March 6,	s.v. <i>Alert</i>	Charlestown
March 6,	s.s. <i>Cornish Merchant</i>	Penryn
March 7,	s.s. <i>Grosvenor</i>	Portsmouth
March 9,	s.s. <i>Tosca</i>	Exmouth
March 10,	s.v. <i>Elsa</i>	Blyth
March 10,	s.v. <i>Kelpie</i>	Falmouth
March 22,	s.s. <i>Horsham</i>	Guernsey
March 24,	s.s. <i>Robrix</i>	Penzance
March 24,	s.v. <i>Lady Roseberry</i>	Plymouth
March 24,	s.v. <i>Solon</i>	Exmouth
March 25,	s.s. <i>Treleigh</i>	Portreath
March 26,	s.v. <i>Gertrude Bay</i>	Exeter
March 28,	s.s. <i>Magrix</i>	Truro
March 31,	m.v. <i>Grit</i>	Torquay

Sailings		
Date	Vessel.	Destination.
March 2,	s.s. <i>Enterpriser</i>	Queenboro
March 4,	m.v. <i>Isabel</i>	Poole
March 6,	s.s. <i>Reedness</i>	Gravesend
March 8,	s.v. <i>Naiad</i>	Rochester
March 8,	s.v. <i>Mount Blairy</i>	Glasgow
March 9,	s.v. <i>Snowflake</i>	Runcorn
March 9,	s.s. <i>Grosvenor</i>	Lancaster
March 10,	s.v. <i>Lady Jean</i>	Rochester
March 10,	s.v. <i>Will Everard</i>	Rochester
March 10,	s.v. <i>Lynher</i>	Plymouth
March 10,	s.v. <i>Alert</i>	Weston Point
March 10,	s.s. <i>Cornish Merchant</i>	Ternuezen
March 12,	s.s. <i>Tosca</i>	Alderney
March 21,	s.v. <i>Elsa</i>	Charlestown
March 24,	s.s. <i>Horsham</i>	Gravesend
March 24,	s.s. <i>Robrix</i>	Charlestown
March 26,	s.v. <i>Solon</i>	Fowey
March 26,	s.s. <i>Treleigh</i>	Falmouth
March 28,	s.v. <i>Lady Roseberry</i>	Rochester
March 31,	s.v. <i>Gertrude May</i>	Rochester

Par Harbour Tide Table, May, 1928

(Greenwich Mean Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Tuesday.....	1	3.14	3.38	11.6
Wednesday.....	2	4.0	4.20	12.0
Thursday.....	3	4.38	4.55	12.4
Friday.....	4	5.12	5.29	12.6

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Saturday	5	5.45	6.1	12.6
Sunday	6	6.17	6.32	12.5
Monday	7	6.47	7.1	12.3
Tuesday	8	7.16	7.32	11.9
Wednesday	9	7.48	8.5	11.3
Thursday	10	8.22	8.41	10.8
Friday	11	9.2	9.26	10.1
Saturday	12	9.53	10.23	9.7
Sunday	13	10.57	11.36	9.4
Monday	14	—	0.19	9.9
Tuesday	15	0.59	1.36	10.7
Wednesday	16	2.9	2.39	11.8
Thursday	17	3.6	3.31	12.7
Friday	18	3.55	4.19	13.4
Saturday	19	4.44	5.8	13.9
Sunday	20	5.32	5.57	13.11
Monday	21	6.21	6.34	13.10
Tuesday	22	7.6	7.29	13.5
Wednesday	23	7.53	8.14	12.8
Thursday	24	8.41	9.6	11.9
Friday	25	9.33	10.2	10.10
Saturday	26	10.33	11.6	10.2
Sunday	27	11.41	—	9.11
Monday	28	0.18	0.54	10.1
Tuesday	29	1.28	1.59	10.6
Wednesday	30	2.27	2.53	11.0
Thursday	31	3.17	3.39	11.5

E. CLEMENS, Harbour Master.

China Clay Exports for March, 1928

A RETURN showing the quantities and values of the exports of China Clay (including Cornish or China Stone), the produce of Great Britain and Northern Ireland, from Great Britain and Northern Ireland, as registered in the month of March, 1928:—

COUNTRY OF DESTINATION.	QUANTITY. Tons.	VALUE. £
Finland	4	17
Sweden	398	903
Norway	756	1,679
Denmark (including Farøe Islands)	1,055	2,560
Germany	2,589	6,253
Netherlands	3,777	8,449
Belgium	4,330	8,464
France	4,593	10,413
Switzerland	80	260
Spain	1,203	2,021
Italy	2,025	4,104
Greece	2	8
China	25	143
United States of America	15,063	35,275
Peru	12	55
Argentine Republic	7	60
Irish Free State	6	22
Natal	12	84
British India, via Bombay	1,403	4,041
Via Madras	5	16
Via Bengal, Assam, Bihar and Orissa	317	913
Australia	50	292
New Zealand	—	3
Canada	47	200
Total	37,759	86,835

March Deliveries A Good Recovery

THERE was a good recovery in the turnover by China Clay firms last month following the February lull, China Clay tonnage being within 2,000 tons of the big January total. China Stone and Ball Clay represented increases of only a few hundred tons. Here are the details of March despatches, together with comparisons with previous months this year and the corresponding months last year:—

PORT.	CHINA CLAY. Tons.	CHINA CLAY. Tons.	CHINA STONE. Tons.	CHINA STONE. Tons.	BALL CLAY. Tons.	BALL CLAY. Tons.	TOTAL. Tons.	TOTAL. Tons.
	1928.	1927.	1928.	1927.	1928.	1927.	1928.	1927.
Falmouth	308	260	—	—	—	—	308	260
Fowey	54,084	53,552	4,576	4,546	1,736	555	60,396	58,633
Looe	179	—	—	—	—	—	179	—
Plymouth	461	1,889	—	—	—	—	461	1,889
Charlestown	4,703	4,909	—	—	—	—	4,703	4,909
Par	3,371	3,308	329	603	—	—	3,700	3,911
Penzance	683	1,612	—	—	—	—	683	1,612
By rail	4,873	5,324	—	—	—	—	4,873	5,324
March	68,665	70,854	4,905	5,149	1,736	555	75,306	76,558
February	47,808	70,312	4,285	4,033	1,243	2,563	53,336	76,908
January	70,578	65,955	5,000	4,375	2,170	2,569	75,766	72,899
Three months	187,051	207,121	12,199	13,557	5,158	5,687	204,408	226,365

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

ANGLO-FOREIGN PULP CO., LTD., London, E.C.—Registered March 7, £10,500 debentures part of £60,000; charged on property known as Bayerische Zellstoffwerke, Regensburg, Germany, also general charge. *£45,500. December 31, 1927.

ASHFORD AND NACCOLT BRICK, TILE AND POTTERIES, LTD.—Registered March 12, £1,900 debentures part of £6,000; charged on properties at Naccolt, etc., also general charge. *£9,097 14s. 4d. January 16, 1928.

GREAT EASTERN BRICK AND TILE WORKS, LTD., London, S.W.—Registered February 28. Trust Deed dated February 9, 1927, securing £15,000 debenture stock; general charge.

MINTON HOLLINS AND CO., LTD., Stoke-on-Trent, tile manufacturers. Registered March 6, £17,000 debentures (secured by Trust Deed dated February 15, 1928); charged on lands and buildings at Stoke-on-Trent, etc., also general charge.

Satisfactions

BOWATER'S PAPER MILLS, LTD., Northfleet.—Satisfaction registered March 5, £4,400, part of amount registered April 16, 1924.

HILL PALMER AND CO., LTD., London, E.C., paper manufacturers.—Satisfaction registered March 20, £100 part of amount registered September 25, 1924.

English China Clays Ltd. Report

THE directors of English China Clays, Ltd., report a net profit of £77,601 for 1927, which compares with £57,622 for 1926. With a final dividend of 1½ per cent. now proposed, the dividend for the year on the ordinary shares is unchanged at 3 per cent., absorbing £40,887 (against £38,070). The preference dividend takes £25,134 (against £21,334). A transfer of £5,000 is to be made to general reserve (against nil) and the "carry forward" increased from £9,394 to £15,974. The regulations of the new Association came into force on January 1. Since the last general meeting the company has acquired the whole of the shares of the Great Halviggan China Clay Co., Imperial Goonbarrow Clays, and Rosevear Clays. In the balance sheet the issued ordinary share capital is shown at £1,413,000, as against £1,269,000 at December 31, 1926, and the issued preference capital at £394,186 (against £307,186). A net item appears on the assets side, "shares and other interests in associated companies £341,694." At the same time the company's general investments show a reduction from £91,656 to £1,004.

China Clay Imports for March, 1928

A RETURN showing the quantities and value of China Clay (including China Stone) imported into Great Britain and Northern Ireland as registered in the month of March, 1928, is as follows:—

COUNTRIES WHENCE CONSIGNED.	QUANTITY. Tons.	VALUE. £
Germany	1	7
Channel Islands	270	540
Irish Free State	10	43
Total	281	590

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China Clay and China Stone Works



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The China Clay Trade Review

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China Clay Prospects

THERE is general agreement in China Clay circles with the interesting observations made by Mr. Reginald Martin (managing director) at the annual meeting of English China Clays, Ltd.—the largest individual firm operating in the industry in the West of England—especially with reference to the opinions he expressed on the newly-formed all-in China Clay Association. If for no other reason, the setting up of an Association should be welcomed as a factor in preventing the disposal of large quantities of a valuable raw material at such a small margin of profit as has operated in regard to common clays since the old Association broke up. There are many producers who can subscribe to Mr. Martin's observations that in 1926 and 1927 a considerable proportion of the total of China Clay despatched was sold at little or no profit.

Combination

MR. MARTIN pointed out that the China Clay industry had got to recognise that its future prosperity lay in combination, either by means of complete capitalisation in one concern, or by means of such an Association as has been set up. An Association such as that now in being may have its weaknesses, but it can be made an organisation of enormous strength if its individual members loyally abide by and observe the regulations and rules made for ensuring its successful operation.

Amalgamation Policy

ENGLISH CHINA CLAYS, LTD., is a firm which is as able as any to carry on without an association, although it has been always one of the most influential advocates and supporters of it. While giving the new organisation their whole-hearted and loyal support, Mr. Martin could not refrain from hinting at the fact that there is no guarantee of its permanence, and pointed out that his own firm, to safeguard their interests and those of their connections, are continuing to pursue a policy of acquiring other properties which are likely to strengthen the position of the company. As the most powerful individual concern in the industry, this, especially from the point of view of the shareholders in the company, is a prudent policy which might eventually enable the company to be the deciding factor in the continuance or otherwise of such an organisation as is now in being.

Mr. Martin's remarks on this aspect of his firm's attitude are not to be taken as in any way a hint that the Association is not firmly established, because from what we understand the machinery of the Association is working smoothly, its members are loyally abiding by the rules, and, what is more, those who are not in such close association with its inner workings as are the members of the Board, very much appreciate the various ways in which the Board is not only making it easy for individual firms to carry out the policy of the Association, but is assisting them in certain directions to do so.

There are prospects that the Association in years to come, if the members stand loyally by it, will be the means of re-establishing the industry on a firm and stable basis, and of

bringing notable advantages to the members in the perhaps not too remote future.

Future Rate Relief for China Clay

AT the annual meeting of English China Clays, Mr. Martin also referred to the fact that rates at the present time constitute a charge of 2s. 9d. upwards on every ton of China Clay produced. This is a serious handicap in securing new markets, where a difference of 6d. per ton is sufficient to induce a manufacturer to use other material in substitution for China Clay. Naturally, the scheme outlined by the Chancellor of the Exchequer for granting relief from the payment of a portion of the rates to such producing firms as those engaged in the China Clay industry, is welcome because of the advantage it will give to the industry, not only in expanding home markets where China Clay is only affected by the use of substitutes, but in foreign countries, where British China Clay producers are coming into direct competition with domestic clays. The relief suggested will be, undoubtedly, a tremendous benefit to the industry, and by the time the scheme comes into operation in the autumn of next year, the industry will be found to be in a position to take full advantage of the increased demand which is expected to accrue, apart from the annual increase in demand which is bound to follow upon the improvement in general trade which is already being seen in this country and on the Continent.

Ceramic Society's Visit

AN event interesting from the point of view of publicity, as well as from other points of view, took place early this month, when the members of the Ceramic Society paid a visit to Cornwall. As a West of England weekly contemporary says: "The visit was made the occasion of a most interesting display of the county's resources in China Clay, and of the ingenuity that has been devoted to its production for commercial use. The clay companies showed the visitors as much as could be crammed into a notable day, from the origin of the clay in the uplands to its exportation at Fowey.

"The Ceramic Society represents that art and industry whose needs led to the first exploitation of China Clay. In the meantime, pottery has become only a minor interest for the clay producer. If only Cookworthy could have foreseen what would have been the result, less than two centuries later, of the journeys of discovery he made into Cornwall, prompted by the experience of the Quaker gentleman who had found kaolin in Virginia, he would have been even more sententiously eloquent about it than he was. At the present time, this extraordinary material, which the Ceramic Society calls (with no derogatory intention, of course) a refractory material, is used in vast quantities for an immense variety of manufactures. It not only bulks largely in the fine art paper on which the modern lady's favourite illustrated papers are printed, but, as Mr. Pochin slyly informed her, is the chief constituent of the powder with which she adorns her refractory nose. The visit introduced the scenery, as well as the industry of Cornwall, to a number of delighted people who had no previous knowledge of either."

Ceramic Society in Cornwall

China Clay and Stone Works Visited

THE visit of representatives of the Ceramic Society to Newquay on May 3 and 4, for the Spring Session of the Refractory Materials Section of the Society, was favoured with delightful weather, and proved a great success. The first day was devoted to the delivery of papers and their discussion, and the second day to visits to China Clay works which are situated at the south of Newquay. The delegates manifested keen interest in the China Clay and China Stone deposits from which are derived the chief basic raw materials used in ceramic manufacture, the best qualities being extensively used in the production of the finest china and porcelain.

The conference session was the nineteenth meeting of the Refractory Materials Section of the Society, and was held on Thursday, May 3, under the chairmanship of Mr. H. J. C. Johnston, president of the Society.

Among those who read papers were: Professor D. A. Moulton, "Refractory Materials Used as Mortar for Laying up Refractories"; Mr. W. J. Rees and Mr. W. Hugill, "The Effect of Substituting High Silica Sand for Some Grades in Lime-bonded Silica Bricks"; Mr. C. M. Gill, "New Developments in Gasworks Carbonising Plant with Special Reference to Refractory Materials"; and Mr. A. T. Green, "The Vitrification of Clay Products." An interesting discussion followed each paper.

Honour for Mr. J. M. Coon

The council meeting in the afternoon was followed by the general meeting, when papers were read by Mr. P. Cooper on "Refractory Formers for Electric Heating Elements; Some Problems in Manufacture and Use"; and Mr. W. Emery, on "Notes on Refractories for Salt Glaze Kilns."

The president announced that Mr. J. M. Coon, of St. Austell, had been elected an honorary life member of the Ceramic Society in recognition of his valued services in connection with investigations and research work in the China Clay industry.

The conference session concluded with a dinner presided over by Mr. H. J. C. Johnston (president). Prominent members of the Society spoke to the toasts, and glowing tributes were paid to the beauties of Newquay by the visitors from the Potteries.

Clay Works Visit

On Friday the members and their friends were the guests of H. D. Pochin and Co., China Clay producers, of St. Austell

and Manchester, who had arranged a most delightful tour of several of their China Clay mines in the St. Austell and St. Stephen's districts. The party, numbering about 50, were conveyed from Newquay to the South Claude Downs China Clay works near Stenalees in two charabancs, and were cordially welcomed by Mr. H. Stanley Pochin, managing director, Mr. D. T. Taylor, director and general manager, Mr. J. W. Higman, Jr., local director, Mr. Richard Hooper, local director and mines manager, Mr. L. G. Hooper, assistant mines manager, and Mr. Arthur Rigby, technical adviser and Potteries representative. Mr. J. R. Catherall represented the G.W.R.

The president and the general honorary secretary (Dr. J. W. Mellor, F.R.S.) expressed the Society's appreciation of the invitation, after which the party followed the directors over this famous mine, which has for more than a century yielded not only a constant supply of China Clay, but China Clay of the finest brand, for which there is great demand in the American market. This mine is 350 ft. in depth, and several members of the party, including ladies, essayed the descent and examined the formation and processes at close quarters.

Mr. Stanley Pochin, accompanied by Mr. Johnston, then escorted the party across the Downs to the waiting cars, whence a most interesting panoramic view of the Bugle section of the China Clay industry was obtained. At the Gunheath works of Pochin and Co., the next stopping place, the visitors had a view of another of the oldest China Clay mines. At these works, the company were particularly interested in the process of production, and several members made a journey to the lowest point (nearly 300 ft.), where an electrically driven pump was lifting 700 gallons of China Clay water per minute. This mine retains its old Cornish pump, which continues to give satisfaction. Both pumps have a lifting capacity of 1,500 gallons per minute, or 3,000,000 tons per annum.

Face Powder £3,000 per Ton

The Gunheath clays have an exceptionally good market, and the works are capable of producing nearly 37,000 tons per annum. A visit to the clay drying kiln was of much interest to the ladies particularly, some of whom as they handled the fine particles of clay with critical interest could not resist the remark that its smoothness reminded them of face powder. Mr. Stanley Pochin informed the ladies that China Clay was



THE CERAMIC SOCIETY VISITING THE WORKS OF H. D. POCHIN AND CO. : A PHOTOGRAPH TAKEN AT ST. DENNIS.

used in the manufacture of toilet powders, and when sold as such worked out at about £3,000 per ton.

The whole company were evidently impressed with the process of production, which was thoroughly explained by representatives of the firm.

The continuation of the tour to the St. Stephen's district, via Greenspalt, afforded to the visitors a most interesting view of St. Austell Bay in the south-east (a marvellous stretch of West Cornwall) and the sea at Newquay.

China Stone Mills

The next stop was at the China Stone Grinding Mills of Messrs. Pochin's, at Terras, St. Stephen's, where the firm have six grinders continuously working, power being derived from a water wheel. Especial interest was evinced in this grinding mill, as the stone is exclusively used in pottery manufacture. The Wheal Remfry China Clay works of Messrs. Pochin's were pointed out on the journey to St. Dennis. A great welcome awaited the visitors at St. Dennis Institute, where a Cornish luncheon was arranged for the firm by Mrs. Richard Hooper, wife of the local mines manager.

Welcome to Pottery Representatives

Mr. H. Stanley Pochin, who presided, expressed the great pleasure it had given him to welcome, on behalf of his firm, the members of the Ceramic Society on the visit to some of their mines. He hoped that the tour would lead to further visits of representatives of the English Potteries.

The President of the Society said that he hoped there would be greater prosperity in the industry, and asked Mr. Pochin and the ladies of St. Dennis to accept the thanks of the Society for their kind welcome.

Miss Barfett, responding for the ladies, said it was gratifying that in that district the very essentials for the potter were found, and the one could not very well get on without the other.

At Fowey Jetties

The party then left for Fowey via Nanpean, Foxhole, and St. Austell. They were impressed with the commercial activity of the China Clay town of St. Austell, where the sales organisations of the various China Clay firms are centralised. From the high ground above St. Austell, an expansive view of St. Austell Bay from Fowey Point to Mevagissey, with Par and Charlestown included in its ambit, was greatly admired. Upon arriving at Fowey Great Western Railway Station, the party were introduced to the superintendent, Mr. W. A. Glasson.

A visit was then paid to the New Jetty, equipped with an electrically operated belt conveyor, which is recognised as the greatest asset for the expeditious loading of China Clay that could possibly be provided. This conveyor, Mr. Catherall informed the visitors, cost the Great Western Railway Co. £200,000, and was an indication of the interest the company had taken in the development of the China Clay industry. Vessels with a carrying capacity of 8,000 and even 10,000 tons could now be loaded expeditiously. A truck of clay was deposited into the hopper constructed within a silo, and the process was explained by Mr. Nimmo, the electrical engineer of the company. The latter part of the inspection was marred by a heavy downpour of rain, the party being hurried to shelter in motor launches.

Mr. Catherall, presiding over the tea, paid a tribute to the interest evinced in the shipping department at Fowey by Mr. W. A. Glasson, and hoped that the future of the China Clay industry would be more prosperous to the producers and general community than it had been for several years past.

The return journey to Newquay was via Par, St. Austell, and St. Stephen's, the party taking away with them pleasant recollections of a memorable visit.

Nova Scotia Infusorial Earth

ACCORDING to the *Canadian Mining and Metallurgical Bulletin* for April, 1928, the Nova Scotia Technical College has inaugurated a special research into the natural properties of infusorial earth and the methods of treatment necessary to prepare the material for the market. There are great deposits of this mineral in every part of the Province, and one of the largest of these is now being exploited by a Canadian company. Special apparatus has been purchased by the College for research work, and it is hoped that definite assistance may be given towards the establishment of a new industry in Nova Scotia.

English China Clays, Ltd.

Retrospect and Forecast at Annual Meeting

THE ninth annual general meeting of English China Clays, Ltd., was held at the Institute of Chartered Accountants, in London, on Thursday, April 26. Mr. R. Martin, chairman and joint managing director, presided.

The chairman, in moving the adoption of the report and accounts, said: "The profit and loss account shows a profit for the year of £77,600 18s. 9d. The directors recommend the transfer to general reserve of £5,000, and the payment of a final dividend of 1½ per cent. (making 3 per cent. for the year) on the ordinary shares, leaving to be carried forward £15,974 18s. 4d., or £6,580 1s. 6d. more than was brought in. The results of the year's working have confirmed the forecast I ventured to make last year that 1927 would prove to be a more prosperous year for your company than its predecessor.

Association Welcomed

"The shipments of China Clay from Devon and Cornwall in 1927 reached the satisfactory total of 920,000 tons, exceeding those of 1926 by 50,000 tons, though it is a regrettable fact, however, that a considerable proportion of the total has been disposed of at little or no profit. Such being the case, it is not surprising that the disastrous effect of the suspension of the Associated China Clays in 1925 has at last been realised, and that it has now become recognised that the only hope for the future prosperity of the trade lies in combination, either by means of a complete financial amalgamation or by means of the newly constituted Associated China Clays.

"The latter alternative is now in being, and it depends entirely upon the loyal co-operation of the constituent members of the Association whether they shall reap the fair remuneration for their capital to which they are surely entitled, or whether the disaster of the recent cut-throat competition shall be repeated. With a membership comprising 90 per cent. of the trade, it should be possible to pull together and keep together for the benefit of all. While we welcome the resuscitation of this Association and will give it our loyal support, we cannot close our eyes to past experience, and with that in view we are steadily pursuing our policy of acquiring such other properties as we are convinced will strengthen our position and will prove valuable assets to the company.

Foreign Competition

"The competition of foreign domestic clays and other substitutes is becoming more and more pronounced, and if we as a trade are to meet this competition successfully the only way of effecting material reduction in cost of production and selling organisation seems to lie in a fusion of interests. Consumers everywhere are driven by force of circumstances to examine their costs more closely than ever, and it is vital if we hope to retain and extend our trade that we as China Clay producers should do the same. There is, however, one item of expenditure bearing heavily on cost of production which can only be relieved from outside. I refer to local rates. These are now averaging, approximately, 14s. in the pound, or, put in other words, they constitute a charge of 2s. 9d. per ton on every ton of China Clay we produce. The concession proposed by the Chancellor of the Exchequer will, of course, be of great benefit not only to us, but to the trade and the country generally, and it affords much-needed relief. (Applause.)

Mr. T. Medland Stocker, J.P., one of the managing directors, seconded the motion, and the chairman having replied to questions, the motion was carried unanimously and the dividend recommendation unanimously approved.

History of the Company

English China Clays, Ltd., which is an amalgamation of The West of England China Clay and Stone Co., Martin Bros., and the North Cornwall China Clay Co., Ltd., was registered in 1919, and paid a dividend of 5 per cent. for the period to the end of that year and of 7½ per cent. for 1920. The distribution was passed in respect of the next two years; 4½ per cent. was paid for 1923, 1924, and 1925, and 3 per cent. for 1926, when trading profits were adversely affected by the coal stoppage. In their report for that year the directors intimated that the results of the dispute would continue to be felt during the early part of 1927. The net profits shown in the balance sheet for the twelve months to December 31 last indicate, however, a satisfactory increase, while they also compare favourably with the figures for 1925 and 1924.

China Clay Notes and News

China Clay Matters in Parliament

MR. KELLY (House of Commons, April 26) asked the Minister of Labour the rate of wages paid to men engaged in the China Clay industry in Cornwall for a normal working week. Mr. Betterton replied that the minimum time rates of wages recognised by the employers' association and the trade union concerned were reported to be 1s. per hour for China Clay workers, and 1s. 1d. for semi-skilled and 1s. for unskilled China Stone workers. The agreement of the Joint Standing Industrial Council for the China Clay Industry provided for a normal week of 42 hours, and for piece-workers to be paid at a rate which would enable them to earn not less than time-and-a-third of the ordinary day rate.

The Budget and China Clay

As one of the producing industries which will benefit under the budget rating relief scheme in eighteen months' time, the China Clay industry welcomes the proposals. Rates have always been a source of much embarrassment in China Clay development, and it is safe to say that several China Clay works that have been forced into liquidation since the slump would have survived and been flourishing concerns to-day had it not been for the crippling burden of the rates when they were not making ends meet. The extra two, three, and in some cases four shillings per ton which the relief will give the industry, will be substantial for it to use in competition with substitutes and domestic clays of foreign countries, and should help considerably in the expansion of the volume of China Clay turnover.

It is of special local interest that Lord Aberconway, the iron and coal magnate, was one of the advisers of the Chancellor of the Exchequer on this part of his Budget proposals. Lord Aberconway is the father of the Honourable H. D. McLaren (his heir), who is largely interested in the China Clay industry, and is chairman of the producers' organisation—The Associated China Clays, Ltd. His lordship was formerly a Liberal M.P. (as was also Mr. McLaren), and is a friend of Sir J. Tudor Walters, the Liberal candidate for this division.

An M.P.'s View

Mr. Geo. Pilcher, M.P. for the Penryn and Falmouth Division, in which St. Austell is situated, speaking at St. Stephens (in the heart of the China Clay district) on the Budget, said that in the China Clay industry, where every penny counted in the competition between Cornwall's second class clays and the second class clays of the United States and Czechoslovakia, the rate levied amounted to an average of 2s. 8d. per ton on the million tons cleared annually from Fowey. Mr. Churchill's Budget would reduce the average rates paid by three-fourths, and the annual assistance thus afforded to that single Cornish industry would amount to £100,000 per year. Mr. Lloyd George's criticism was to the effect that the money was taken from three-quarters of the people and given to a quarter of them. The Government believed that if a new confidence and a material contribution in relief of heavy rate charges could be given to the employers, the workers as a whole, and the tax-paying community as a whole, would reap the benefit. Every worker in the clay district would rejoice if Cornish clays stood on better ground in competition with foreign clays.

New Rating System

The work of preparing for the bringing into operation of the new Rating and Valuation Act is of a protracted character, and in straightening out a number of anomalies and the making of a variety of adjustments to ensure uniformity and equitable treatment, calls for the exercise of plenty of tact and diplomacy, coupled with reasonable firmness where the issues are not simple. Mr. A. S. Coldham (clerk to the St. Austell Rural District Council), as clerk to the committee, is proving himself equal to the complicated task of advising his councillors on the technicalities of the law.

One formidable difficulty has been overcome as a result of diplomatic handling of the situation. We refer to the valuation of the China Clay works, about which there was a very acute conflict of opinion when the Council's committee started to tackle the question a few months ago. It is understood that the China Clay industry and the rating authority have

since arrived at a basis that is acceptable to all parties, which will obviate the legal conflict that was feared. It is gratifying to all concerned to know that the sweet reasonableness which THE CHINA CLAY TRADE REVIEW advocated at the time has prevailed, and in bringing this about, Mr. Coldham has had a hand.

Electro-technical Porcelains

Claim is made that the most advantageous molecular formula for the manufacture of electro-technical porcelains is $0.25 \text{ RO}, \text{Al}_2\text{O}_3, 4 \text{ SiO}_2$ and that pastes with a soda or potash base are preferable to those with a lime base. Great variation is displayed, however, in the composition of porcelain insulators made by different manufacturers. This is particularly so in the case of silica or alumina content.

During the examination of porcelains manufactured in different countries which had all been in service for a similar period, the silica content was found to vary from 64 to 73 per cent., and the alumina content from 21 to 28 per cent. of the porcelain. It was found that a number of manufacturers had introduced CaO into their mixtures. On testing the relation between chemical composition, method of manufacture, texture of the porcelains, and their behaviour under service, the least successful results were obtained from those with a high ratio of SiO_2 to Al_2O_3 . In these, defects in manufacture were detected.

The importance of regular composition cannot be too highly appreciated. Although free silica is claimed to increase the dielectric strength, its avoidance in electro-technical porcelain should be observed. Silica should not be present in a free state such as may be in quartz, which alters in solidity under varying temperatures; hence the advocacy of replacing quartz with some other substitute. The suggestion is made that a porcelain into the composition of which some inert substance such as natural or synthetic sillimanite, kaolin, alumina, and highly calcined zirconia enters would prove more satisfactory than one into which quartz is introduced. Then again, felspar might with advantage be replaced by silicates of alumina or magnesia, by natural or synthetic silicates of beryllium or the alkalies. Felspar is not considered sufficiently elastic, and is rather fragile for successful products. Another objection to its use is its capability of acting as an electrolyte, with serious results.

Ontario China Clay Developments

The development of the China Clay deposits on the Mattagami River in Northern Ontario is likely to become an accomplished fact this summer as a result of the extension northward of the Temiskaming and Northern Ontario Railway. Mr. William Douglas, president of the Northern Ontario China Clay Corporation, Ltd., has informed the *Toronto Globe* that the company has been financed for the construction of a plant on its property eight miles below Smoky Falls. He pointed out that a survey had been made from the end of the existing steel track on the Temiskaming and Northern Ontario Railway at Coral Rapids to their property twelve miles away. Provided transportation facilities were ready for them in the summer, the company would be prepared to despatch clay and would probably market some clay in any case. According to Mr. Douglas the deposits contain fireclay, China Clay, and silica sand, and he believes the China Clay to be as good as that obtained from other sources. In Canada, it is largely used in the coating and filling of papers. It is intended to use the fireclay in conjunction with silica sand in making silica brick, fire brick, gannister brick and other bricks. It is proposed to turn out various other products, including pigments, colloidal clay, alumina oxide and carborundum.

A Useful Publication

Since the beginning of the present year the Building Research Station of the Department of Scientific and Industrial Research has commenced the publication of *Building Science Abstracts* (H.M. Stationery Office, monthly, 9d. per copy, or 10s. per year). The abstracts are grouped under a number of headings, of which the first is "Stone, Mineral Earths, Clay, and Ceramics," and occasionally contains matters of interest to those concerned with China Clay.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay, with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—April, 1928

Arrived.	Name.	Sailed.	Destination.
April 1, s.v. <i>Standard</i>		April 12, Halden	
April 1, s.s. <i>Devon Coast</i>		April 4, Liverpool	
April 1, s.s. <i>Coralstone</i>		April 5, Manitiwoc and Milwaukee	
April 1, s.v. <i>Meta</i>		April 13, Plymouth	
April 2, s.v. <i>Francis & Jane</i>		April 12, Sunderland	
April 3, m.v. <i>Matilda</i>		April 12, Penryn	
April 4, s.s. <i>Dorrien Rose</i>		April 11, Ghent	
April 4, s.s. <i>Gouwestroom</i>		April 7, Amsterdam	
April 4, s.s. <i>Goole</i>		April 5, Gravesend	
April 5, s.s. <i>Ole Aarvold</i>		April 13, Southaven	
April 6, s.s. <i>Castor</i>		April 13, Sarpsborg	
April 6, s.s. <i>Bill</i>		April 11, Milwaukee	
April 6, s.s. <i>Wild Rose</i>		April 14, Rouen	
April 7, s.v. <i>Carmenta</i>		April 12, Newcastle	
April 8, s.s. <i>Goodig</i>		April 13, Antwerp	
April 8, s.s. <i>Pansy</i>		April 13, Leith	
April 8, s.s. <i>Brier Rose</i>		April 12, Preston	
April 8, s.s. <i>Elfstone</i>		April 12, Southaven	
April 8, s.s. <i>Farfield</i>		April 12, Grimsby	
April 9, s.s. <i>Dorrit</i>		April 12, Seville	
April 10, s.s. <i>Guelder Rose</i>		April 13, Rouen	
April 10, s.s. <i>Rayford</i>		April 14, Leith	
April 11, s.s. <i>Hayle</i>		April 14, Preston	
April 13, s.s. <i>Sturdee Rose</i>		April 17, Weston Pt.	
April 14, s.s. <i>Sambre</i>		April 18, Bilbao	
April 14, s.v. <i>Naiaid</i>		April 16, Par	
April 14, s.s. <i>Nermo</i>		April 17, Genoa	
April 16, s.s. <i>Schelledam</i>		April 17, Terneuzen	
April 16, s.s. <i>Tynebridge</i>		April 24, Portland, Me.	
April 17, m.v. <i>Dietrich Hasseldieck</i>		April 17, Hamburg	
April 17, m.v. <i>Ansonia</i>		April 20, Castellamare	
April 17, s.s. <i>Gouwestroom</i>		April 20, Amsterdam	
April 18, s.s. <i>Joffe Rose</i>		April 20, Weston Pt.	
April 18, s.s. <i>Blush Rose</i>		April 21, Runcorn	
April 18, s.v. <i>Lady Jean</i>		April 27, Aylesford	
April 19, s.s. <i>Foch Rose</i>		April 21, Runcorn	
April 19, s.v. <i>Agiena II.</i>		April 21, Granton	
April 19, s.s. <i>Primrose</i>		April 21	
April 19, s.s. <i>Wild Rose</i>		April 23, Preston	
April 20, s.s. <i>Guelder Rose</i>		April 24, Grangemouth	
April 20, m.v. <i>Oosterschelde</i>		April 25, Hamburg	
April 20, s.s. <i>Aslak</i>		April 26, Skien	
April 20, s.s. <i>Torpoint</i>		April 24, Cardiff	
April 21, s.s. <i>Mersey</i>		April 25, Ridham	
April 22, s.s. <i>Chifuku Maru</i>		April 28, Portland, Me.	
April 22, s.s. <i>Fivby</i>		Philadelphia	
April 23, s.v. <i>Flying Foam</i>		April 25, Truro	
April 24, s.s. <i>Goole</i>		April 28, Gravesend	
April 24, s.s. <i>Hayle</i>		April 26, Runcorn	
April 25, s.s. <i>Ravenspoint</i>		April 28, Genoa	
April 25, s.s. <i>Farfield</i>		April 28, Grimsby	
April 26, s.s. <i>Borg</i>		May 1, Sarpsborg	
April 26, s.s. <i>Portland Maru</i>		Boston and Philadelphia	
April 26, s.s. <i>Sturdee Rose</i>		April 30, Brussels	
April 26, m.v. <i>Romanie</i>		April 30, Aviles	
April 27, m.v. <i>Hetty</i>		May 1, Gloucester	
April 28, m.v. <i>Lydia Cardell</i>		Rouen	
April 28, s.s. <i>Blush Rose</i>		Weston Pt.	
April 28, s.s. <i>Mersey</i>		May 1, Leith	
April 29, s.s. <i>Evelyn Manor</i>		Aberdeen and Leith	
April 30, s.s. <i>Biskra</i>		Southaven	
April 30, s.v. <i>Raymond</i>		Charlestown	

Charlestown Shipping—April, 1928

Date.	Vessel.	Destination.
April 4, <i>St. Anne</i>		Nantes
April 5, <i>Guiding Star</i>		Runcorn
April 13, <i>Kale</i>		Rochester
April 14, <i>C. F. Nurse</i>		Rochester
April 21, <i>Fulgens</i>		Aberdeen
April 23, s.s. <i>Knowlgrave</i>		Gravesend
April 25, <i>Leader</i>		Runcorn
April 27, <i>Lady Daphne</i>		Rochester

Penzance Shipping—April, 1928

Arrived.	Name.	From.	Sailed.	Destination.
April 4, s.s. <i>Ridness</i>		St. Ives	April 6, Ridham	
April 4, s.s. <i>Mersey</i>		Falmouth	April 8, Ridham	
April 6, s.v. <i>Lady Agnes</i>		Plymouth	April 18, Greenbythe	
April 12, s.v. <i>Mary Barrow</i>		Rochester	April 28, Rochester	
April 26, s.v. <i>Mary Miller</i>		Porthleven	May 4, Firth of Forth	

Par Harbour Shipping—April, 1928

Date.	Vessel.	From.
April 1, m.v. <i>Isabel</i>		Porthostock
April 2, s.s. <i>Trader</i>		London
April 3, s.v. <i>Snowflake</i>		Garston
April 6, s.s. <i>Treleigh</i>		Falmouth
April 12, m.v. <i>Isabel</i>		Truro
April 12, s.s. <i>Pegrix</i>		Exeter
April 13, s.v. <i>Alert</i>		Truro
April 14, m.v. <i>Frida Both</i>		Poole
April 16, s.v. <i>Naiaid</i>		Penzance
April 17, s.v. <i>Diligent</i>		Mevagissey
April 20, m.v. <i>Saltash</i>		Plymouth
April 22, s.s. <i>Farfield</i>		Blyth
April 21, s.s. <i>Hayle</i>		Preston
April 26, s.v. <i>Lady Roseberry</i>		Plymouth
April 29, s.v. <i>Hero</i>		Falmouth
April 30, s.s. <i>Grosvenor</i>		Plymouth

Date.	Vessel.	Destination.
April 1, s.s. <i>Magrix</i>		Gravesend
April 4, m.v. <i>Isabel</i>		Poole
April 4, s.s. <i>Trader</i>		Penryn
April 5, m.v. <i>Grit</i>		Rochester
April 7, s.s. <i>Treleigh</i>		Preston
April 16, s.s. <i>Pegrix</i>		Gravesend
April 17, s.v. <i>Snowflake</i>		Runcorn
April 17, m.v. <i>Isabel</i>		Plymouth
April 18, s.v. <i>Alert</i>		Weston Point
April 18, m.v. <i>Frida Both</i>		Raumo
April 18, s.v. <i>Diligent</i>		Plymouth
April 20, s.v. <i>Naiaid</i>		Erith
April 20, m.v. <i>Saltash</i>		Plymouth
April 24, s.s. <i>Hayle</i>		Fowey
April 26, s.s. <i>Farfield</i>		Fowey
April 29, s.v. <i>Lady Roseberry</i>		Rochester

Par Harbour Tide Table, June, 1928

(British Summer Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Friday	1	5.0	5.20	11.9
Saturday	2	5.40	5.59	11.11
Sunday	3	6.17	6.35	12.0
Monday	4	6.53	7.10	12.0
Tuesday	5	7.26	7.43	11.11
Wednesday	6	8.0	8.17	11.8
Thursday	7	8.34	8.52	11.4
Friday	8	9.11	9.31	11.0
Saturday	9	9.52	10.15	10.7
Sunday	10	10.40	11.8	10.4
Monday	11	11.38	—	10.2
Tuesday	12	0.9	0.42	10.4
Wednesday	13	1.16	1.50	10.11
Thursday	14	2.23	2.55	11.7
Friday	15	3.26	3.56	12.4
Saturday	16	4.25	4.53	12.11
Sunday	17	5.20	5.47	13.3
Monday	18	6.14	6.41	13.4
Tuesday	19	7.8	7.34	13.4
Wednesday	20	7.59	8.23	13.0
Thursday	21	8.46	9.8	12.5
Friday	22	9.31	9.54	11.9
Saturday	23	10.17	10.41	11.2
Sunday	24	11.5	11.29	10.6
Monday	25	11.54	—	10.2
Tuesday	26	0.21	0.51	10.0
Wednesday	27	1.22	1.54	10.1
Thursday	28	2.26	2.57	10.4
Friday	29	3.26	3.53	10.8
Saturday	30	4.19	4.43	11.1

E. CLEMENS, Harbour Master.

China Clay Exports for April, 1928

A RETURN showing the quantities and values of the exports of China Clay, including Cornish or China stone, the produce of Great Britain and Northern Ireland, from Great Britain and Northern Ireland as registered in the month of April, 1928, is as follows:—

COUNTRY OF DESTINATION.	QUANTITY. Tons.	VALUE £
Finland	361	469
Sweden	475	1,490
Norway	2,149	5,737
Denmark (including Farøe Islands)	782	2,350
Poland (including Dantzig)	1	3
Germany	2,955	6,075
Netherlands	2,104	4,740
Belgium	5,374	9,942
France	2,977	5,904
Spain	1,993	6,156
Canary Islands	627	831
Italy	2,922	5,479
Greece	10	90
Turkey, Asiatic	1	3
Iraq	5	24
China	3	23
United States of America	31,461	71,221
Mexico	108	474
Colombia	1	16
Brazil	4	17
Irish Free State	—	1
Cape of Good Hope	2	10
Transvaal	282	1,190
Bombay	361	1,609
Bengal, Assam, Bihar and Orissa	421	1,214
Australia	36	159
Canada	126	695
Total	55,541	125,898

China Clay Imports for April, 1928

A RETURN showing the quantities and value of China Clay (including China Stone) imported into Great Britain and Northern Ireland as registered in the month of April, 1928:—

Countries Whence Consigned.	Quantities. Tons.	Value. £
Norway	—	8
Germany	1	12
Belgium	5	22
U.S. America	29	167
Total	35	209

Artificial Vitrifying Agents

A Bureau of Standards Investigation

An investigation is being conducted at the Columbus Branch of the U.S. Bureau of Standards to determine the effect of artificial vitrifying agents in ceramic bodies. It is hoped by this investigation to lower the maturing temperature of a given body or to affect a greater vitrification and corresponding translucency at the same temperature. After a preliminary survey of the data available, the problem was attacked by choosing certain eutectic mixtures which deform below cone 5, 1,229° C. (2,245° F.). These eutectics, prepared as fritted glasses, constitute the source of the artificial vitrifying agents employed in the bodies. The eutectics between the following materials were chosen: Feldspar-steatite; albite-calcite; sodium silicate-calcium silicate; albite-microcline; albite-magnesite; barium oxide-B₂O₃; calcium oxide-B₂O₃; barium silicate-sodium silicate; sodium silicate-magnesium silicate; microcline-albite-CaO.Al₂O₃-SiO₂; K₂O-SiO₂; K₂O-Al₂O₃-SiO₂; Na₂O-SiO₂; Na₂O-SiO₂-Al₂O₃; BaO-Al₂O₃-SiO₂; Na₂O-B₂O₃-SiO₂; K₂O-B₂O₃-SiO₂; Na₂AlF₆-Al₂O₃.

As a preliminary test, it was decided to make a cone deformation study which would also serve as a key to the degree of vitrification of the fritted bodies. Hence, the frits were incorporated in a basic porcelain body composed of 16 per cent. feldspar; 10 per cent. No. 4 Kentucky ball clay; 35 per cent. British China Clay; and 39 per cent. flint.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

CATTYBROOK BRICK CO., LTD. Registered April 28, £4,000 debentures (dated March 29, 1928) part of amount already registered; charged on properties at Cattybrook, etc., also general charge. *£13,000. April 12, 1928.

EMERY (W. L.) POTTERY LTD., Stoke-on-Trent. Registered April 17, debenture to Bank; general charge.

RIDLEY (W.) AND CO., LTD., Leicester, paper manufacturers. Registered April 2, £1,600 mortgage, to J. A. Hayes Hawkestone. West Hill Road, Western Park, Leicester, hosiery manufacturer; charged on property in Eastleigh Road, Leicester. *£1,010. August 1, 1927.

WATKIN BRICK CO., LTD., New Duston. Registered April 26, £5,500 debentures; general charge.

WORCESTER ROYAL PORCELAIN CO., LTD. Registered April 12, series of £15,000 debentures, present issue of £7,000; general charge. *£50,000. April 2, 1927.

Satisfactions

BARNES (SOUTHSEA), LTD., paper manufacturers. Satisfaction registered April 21, £2,000 registered June 4, 1912.

CATTYBROOK BRICK CO., LTD. Satisfaction registered April 28, £7,200 part of amount registered January 10, 1905.

RIDLEY (W.) AND CO., LTD., Leicester, paper manufacturers. Satisfaction registered April 2, all moneys, etc., registered April 11, 1924.

London Gazette, &c.

Partnership Dissolved

W. A. PEAKE AND CO., (Harry EARDLEY, Charles Alexander STEVENS, Tom ROWLEY, the Elder, William ROWLEY, William James ROWLEY, John ROWLEY, and Tom ROWLEY, the Younger), brick and tile manufacturers, Hanford Tileries, Hanford, by mutual consent as from July 25, 1927. Debts received and paid by T. Rowley, the Elder, W. Rowley, W. J. Rowley, J. Rowley and T. Rowley, the Younger.

April Deliveries

HAVING regard to the fact that there were five Mondays in April, a day less and two days holidays which did not apply to March, the total turnover was well up to last month. The actual tonnage shipped was 67,132 against 75,306 in March, of this 61,498 tons being represented by China Clay against 68,665. The total for the four months compared with 1927 is now nearly 29,000 tons below the corresponding 4 months last year, but shipments in May and June are expected to overtake this adverse balance. The following were the statistics for April compared with other corresponding periods:—

	CHINA CLAY.		CHINA STONE.		BALL CLAY.		TOTAL.	
Port.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1928.	1927.	1928.	1927.	1928.	1927.	1928.	1927.	
Falmouth ..	16	560	—	—	—	—	16	560
Fowey ..	52,578	59,658	3,981	3,920	1,409	2,316	57,868	65,894
Tool	216	—	—	—	—	—	216	—
Par	920	4,436	244	42	—	—	1,164	4,478
Penzance ..	1,435	867	—	—	—	—	1,435	867
Plymouth ..	1,052	655	—	—	—	—	1,052	655
Charlestown ..	1,761	6,240	—	—	—	—	1,761	6,240
By rail	3,520	5,301	—	—	—	—	3,520	5,301
April	61,498	77,717	4,225	3,962	1,409	2,316	67,132	83,995
3 months ...	187,051	207,121	12,199	13,557	5,158	5,687	204,408	226,365
4 months ..	248,549	284,838	16,324	17,519	6,567	7,403	271,540	310,365

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The China Clay Trade Review

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China Clay and Rating Relief Scheme

THE efforts which the organisation representing the bulk of the China Clay industry (Associated China Clays, Ltd.), through the good offices of Mr. George Pilcher, M.P. has been making to establish beyond all shadow of a doubt that the industry will come within the scope of the Budget proposals for rate relief next year, will be read with a good deal of interest in China Clay circles.

The correspondence on the subject that has passed between Mr. Pilcher, M.P., the Chancellor of the Exchequer, and the Minister of Health, raises once more the question as to whether China Clay can be regarded as a mineral or a stone. Many years ago there was a big discussion on the subject, arising out of a railway case in which the G.W.R. sought to prove that China Clay was not a mineral and therefore that they were not liable to compensation in respect thereof when deposits were rendered unworkable through the railway requiring the site for a line.

Having It Both Ways

For the purpose of the Budget rating proposals, under which productive industry is to be relieved of two-thirds of the rates which it now pays, Mr. Neville Chamberlain settles the question in such a way that the China Clay industry appears to be able to have it both ways; whether some clay works can be described as mines and others as quarries, the Minister seems to place the question beyond all dispute that the industry comes within the scope of the Government's scheme. Nevertheless, it is a matter for satisfaction that the question has been cleared up thus early in the discussion, such being the intricacies and ambiguities of Bills and Acts of Parliament that there was a possibility that if it was decided that China Clay works were neither mines nor quarries they might have been considered outside the scope of the proposals. Mr. Chamberlain's statement is quite definite: "It would seem, therefore, that every place from which China Clay is obtained (whether mine or quarry) will be an industrial hereditament within the meaning of the Rating and Valuation (Apportionment) Bill."

Minister's Ingenious Definition

Mr. Chamberlain's definition of a China Clay mine and a China Clay quarry is ingenious but hardly in accord with the actual practice. He says: "I am advised that where clay is obtained by sinking a shaft, the place from which it is obtained is a mine within the meaning of the Metalliferous Mines Act, 1872, and where the clay is obtained by cutting the surface of the ground, the place where the clay is obtained is a quarry."

As a matter of fact, as those engaged in China Clay production are well aware, all China Clay is obtained from the working of the surface of the ground, the shaft sinking in connection with it being for the purpose of conducting the liquid clay from the bottom of the open workings to the surface works. Mr. Chamberlain seems to have been advised that shaft sinking is employed in some works and not in others, but in all China Clay works shaft sinking is resorted to to connect up with the level at the base of the

pit, into which the washed clay runs to be pumped up through the shaft. Were the fact that clay works employed shafts to entitle them to be designated mines under the Metalliferous Mines Acts, the industry would be able to claim valuation for rating purposes under the system permitted under that Act, which they have been informed they cannot do.

A Good Case Made Out

Had the clearing up of the question put forward by Mr. Pilcher been less simple that it has fortunately proved to be, a good case was made out to show that the industry is in need of the rating concession proposed. Rated as the industry is to the equivalent of 2s. 6d. to 3s. 6d. per ton on every ton of China Clay marketed, the relief is matter of great importance when it is realised that oftentimes a matter of a few pence per ton, sometimes less than 6d., makes all the difference in a buyer deciding on a foreign-produced clay or a cheaper substitute. Having a margin of 1s. 8d. to 2s. per ton to play with, which is about what the relief will mean to the China Clay industry, producers will be placed on a much more favourable basis for competing with foreign competitors who, even then, will be more favourably placed for doing business in consequence of their burdens being lighter. The effect of the Government's rating proposals will be to give an impetus to the production and increased use of China Clay, which is bound to benefit the West of England materially and to increase the prosperity and employment possibilities of the industrial population.

Advantages of Association

The position of the industry in having been able to approach the Government as a composite authority is another proof of the advantage of having an organised body who can be the mouthpiece of practically all the producers, and speak with a united voice. Thus are the blessings of association exemplified so early in the existence of Associated China Clays, Ltd.

Clay Imports and Exports for May

THE Board of Trade Returns for May indicate that exports of China Clay (including Cornish or China Stone) in the month ended May 31, amounted to 54,099 tons (valued at £121,287) as compared with 67,208 tons (valued at £141,660) in May, 1927, and 54,377 tons (valued at £112,442) in May, 1926. For the five months ended May 31, 1928, exports amounted to 243,695 tons (valued at £539,094) as compared with 268,828 tons (valued at £572,960), and 253,234 tons (valued at £524,698) in the corresponding periods in 1927, and 1926 respectively. Exports of fireclay in May amounted to 5,593 tons (value £8,763) as compared with 1,955 tons (value £4,063) and 1,260 tons (value £2,987) in 1927 and 1926. For the five months ended May 31, 1928, exports of fireclay amounted to 16,427 tons (value £28,207), as compared with 4,063 tons (value £28,244) and 2,987 tons (value £20,087) in 1927 and 1926. For the five month period, total exports of all forms of clay (China, fire and other) were valued at £632,842, as compared with £685,288 and £642,627 in 1927 and 1926.

China Clay Industry and Budget Rating Relief Scheme

Interesting Correspondence with the Government

As some doubt had been expressed as to whether the China Clay industry would come within the scope of Mr. Churchill's Budget proposals with reference to the scheme for rating relief for industry, Associated China Clays, Ltd., which represents a preponderating proportion of firms engaged in the industry, has enlisted the co-operation of Mr. George Pilcher, M.P. for the Penryn-Falmouth Division (in which most of the China Clay works are situated), and also of other West of England Members of Parliament, to clear the matter up. On May 29 Associated China Clays, Ltd., which is the spokesman of at least 90 per cent. of the industry, telegraphed to Mr. Pilcher and the other West-country members with a view to dispelling the anxiety felt lest China Clay should be left outside the scope of the Government's rating scheme.

Representations made stated that "the inspection of China Clay pits is provided for under the Quarries Act, 1894, and the new Rating Bill provides only for the de-rating of agricultural, industrial, and transport hereditaments." Some assurance was therefore sought that quarries were certain of inclusion, either as mines, factories, or workshops, in the classification "industrial hereditaments."

Mr. Pilcher took the matter up without delay, and, getting into touch with both the Chancellor of the Exchequer and the Minister of Health, cited all the definition clauses of the Bill, and pointed out that there appeared to be a possibility that through the interpretation that might be placed upon these clauses, China Clay might fall between two stools and be placed in neither of the categories of mine or factory.

Minister's Distinction Over China Clay Production

In his reply to Mr. Pilcher, the Minister of Health drew a distinction between two classes of China Clay works, suggesting that in some works China Clay is obtained by the sinking of a shaft, and in the other by merely exploiting the surface of the ground. The first was therefore designated a mine, and the latter a quarry.

"It would seem, therefore," Mr. Chamberlain goes on, "that every place from which China Clay is obtained will be an industrial hereditament within the meaning of the Rating and Valuation (Apportionment) Bill. If it is not a 'mine' it will be a quarry, which is a 'factory' or 'workshop' as being specifically mentioned in the Factory or Workshop Act, 1901."

Below we give the full text of the important correspondence which has passed between Mr. Pilcher and the Treasury and the Ministry of Health. The following letter was sent first to Mr. Churchill, who replied to Mr. Pilcher advising him to send it to the Ministry of Health:—

"Dear Mr. Churchill,

"The Associated China Clays, Ltd., being the representative association to which the majority of the firms and companies working China Clay belong, are anxious as to their position in relation to your proposals for the partial de-rating of 'premises used for the purpose of production.'

"You will perhaps have observed that relying on the obvious purpose underlying the definition of the Government's intentions contained in your Budget speech (e.g., columns 848 and 864 Hansard) at least one chairman of a China Clay company (English China Clays, Ltd.) expressed his gratification at the great benefit and the much-needed relief which would accrue to his industry through your proposals.

"I myself went further in a public speech which I delivered in my constituency at the China Clay centre of St. Stephens, and basing myself on the undoubted productive character of the industry and the known incidence of rates per ton on the disposal commodity, estimated the monetary value of the relief to the industry at not less than £100,000 per annum.

"Strong apprehensions are now expressed on the ground that in the Rating and Valuation (Apportionment) Bill, powers are taken distinguishing only three classes of hereditaments—agricultural, industrial, and freight transport hereditaments—and that an industrial hereditament under which alone China Clay works can fall to be distinguished is defined as

an 'hereditament occupied and used as a mine or subject as hereinafter provided as a factory or workshop.'

Definition of Terms

"I enclose excerpts of all those passages from Statute which are cited in Section 3 of the new Bill to assist in the definition of terms 'mine,' 'factory,' or 'workshop.' From the fact that China Clay works are provided for under the Regulation of Quarries Act, 1894, it is apparent that they are not treated as mines, for that Act is limited in its operation to 'every place (not being a mine) in which persons work,' etc. The appropriate sections of the Metalliferous Mines and Coal Mine Act, 1872, and of the Coal Mines Act, 1911, suggest the same presumption.

"Presumably the China Clay pit is regarded officially as a 'non-textile factory,' inasmuch as 'quarries' are included (No. 26 of Part 2 of the Sixth Schedule, Factory and Workshop Act, 1901) among places to be so regarded under the Factory and Workshop Act. Nevertheless, the definition there given does not include a China Clay pit, and by the Quarries Act, 1894, the inspection of clay pits is conducted by inspectors appointed under the Metalliferous Mines Act. In other words, China Clay stands to fall between two stools.

"When the 'distinguished process' is completed it may find itself omitted from the classification 'industrial hereditament' on the ground that China Clay works are neither mine, factory nor workshop.

"I shall be deeply grateful for an assurance, either that these apprehensions are entirely unfounded, or that steps will be taken either during or before the Committee stage of the Bill to remove an ambiguity which may have disastrous results for one of our most important mineral trades.

"For your information I may state that the production of China Clay in the United Kingdom in 1925 amounted to 1,114,000 tons, valued at £1,532,000. Of that quantity 652,576 tons, valued at £1,350,000, was exported. Of the foreign China Clays used in the United States, 81 per cent. are derived from this country, and nearly half the total quantity employed in the United States is of British origin.

Competition of Foreign Domestic Clays

"On the other hand, whereas in 1926 the quantity of foreign clays consumed in the United States increased by 6 per cent., those of American origin increased by 18 per cent. More particularly in the sphere of second class clays, of which new workings have been opened up recently in the United States, Czechoslovakia, India, Canada and South Africa, the competition of European and other non-United Kingdom clays is becoming increasingly formidable. In part from that cause and in part from the increasing mechanisation of the industry with a view to reduction of production costs, there has been a tendency towards unemployment among the Cornish and other China Clay workers, which it is hoped that the Government's de-rating proposals will suffice to check.

"I may add that a reduction of the overall costs of the production of English China Clays cannot be without its beneficial effect upon important dependent industries, such as paper making, potteries, and bleaching. Rates paid in the Cornish China Clay area stand at approximately 14s. in the £, equivalent to between 2s. 6d. and 3s. on every ton marketed. A reduction of even 1s. would place British China Clays in undoubted possession of markets on which their hold is now increasingly precarious. The present return to capital invested in the industry is, generally speaking, low. The labour force engaged amounts to several thousand. The China Clay industry will be very grateful for an assurance that there is no occasion for the apprehensions expressed in this letter."

GEORGE PILCHER.

June 1.

Clay Mine or Quarry?

The following is the reply of the Ministry of Health:—

"I am desired by Mr. Chamberlain to say in reply to your letter with regard to China Clay works, that he is advised that where the clay is obtained by sinking a shaft, the place

from which it is obtained is a mine within the meaning of the Metalliferous Mines Act, 1872, and where the clay is obtained by cutting the surface of the ground the place where the clay is obtained is a quarry.

"It would seem, therefore, that every place from which China Clay is obtained will be an industrial hereditament within the meaning of the Rating and Valuation (Apportionment) Bill; if it is not a mine it will be a quarry, which is a 'factory' or 'workshop,' as being specifically mentioned in Part 2 of the Sixth Schedule of the Factories and Workshops Act, 1901."

The Nature of Clay

Significance of the Weathering Cycle

PROFESSOR G. W. ROBINSON, head of the Department of Agricultural Chemistry in the University of North Wales at Bangor, contributes an interesting letter, under the heading of "The Nature of Clay and its Significance in the Weathering Cycle," to *Nature* of June 9. Professor Robinson's remarks are as follows:—

"The characteristic constituent of the natural substance, clay, has been the subject of numerous investigations both by chemists and by pedologists. It is generally believed to be colloidal, and the residual product of the hydrolytic decomposition of mineral silicates. Whilst attempts have been made to study this complex by methods of acid extraction, the most promising line of advance has been the study of the finest fraction obtained in mechanical analysis—the so-called colloidal clay. Although this fraction, as isolated by some workers, may contain small proportions of unweathered material, we shall probably not err greatly in equating it with the weathering complex, particularly if a critical settling velocity of less than 10^{-4} cm./sec. has been used in its separation by means of sedimentation.

American Work

"Considerations of space in the present communication preclude a full reference to recent work, but I would direct particular attention to an important investigation by W. O. Robinson and R. S. Holmes (*U.S. Dept. Agr. Bull.*, 1311, 1924). In this work the authors report the composition of the colloidal clay from a number of North American soils. Perhaps their most important conclusion is that iron compounds, other than hydrated ferric oxide, are present as an essential part of the clay.

"Much of the confusion in the study of clay has arisen from regarding the clay complex as essentially an aluminium silicate of aluminosilicic acid, with hydrated ferric oxide present as an adventitious constituent. Robinson and Holmes examine the possibility that the clay complex is a mixture of an aluminium silicate of the kaolinite type ($\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$) and a ferric silicate of the nontronite type ($\text{Fe}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$). Actually only a minority of their clays fit this hypothesis. On one hand there are clays with excess of silica, and, on the other hand, clays with excess of sesquioxides—the latter clays being generally of a reddish or brownish colour.

"The hypothesis examined by Robinson and Holmes could, however, only be verified by the examination of clays obtained from material which had originated directly from crystalline rocks and had, further, not been subjected to those leaching processes which cause a differentiation of the silica-sesquioxide complex. These changes result, in humid temperate climates, in the impoverishment of the surface in sesquioxides and the enrichment of a subsurface layer in these constituents. In extreme cases, in the so-called pod-sols, acid leaching gives rise to a bleached A horizon and a reddish brown, sometimes indurated, B horizon, which is relatively rich in sesquioxides.

The Silica-Sesquioxide Ratio

"It is somewhat difficult to obtain material in which the silica-sesquioxide complex has not undergone some alteration, but I obtained, through the courtesy of Mr. Edward Greenly, three samples of clay from Anglesey which had originated from Mona Complex schists at a depth far below that at which the ordinary leaching processes operate. The clay fraction from a white clay gave a molecular ratio of silica to sesqui-

oxides of 2.16; for a yellow clay the ratio was 2.09; and for a red clay 1.96. These figures are in fair agreement with the 2.0 ratio demanded by the kaolinite-nontronite hypothesis.

"I have also examined a number of North Wales soils, derived from the crystalline or consolidated rocks, in which it can be assumed that the clay is of primary origin. The average silica-sesquioxide ratio for the clay fraction of 17 such soils was 1.90, the individual ratios ranging from 1.51 to 2.22. Bearing in mind the tendency under the conditions of North Wales, for sesquioxides to be leached down to lower levels, and also remembering that superficial erosion attacks the more silicious A horizon, the fact that the ratio is less than 2.0 is in harmony with the hypothesis that the primary weathering product is a mixture of silicates of the kaolinite and nontronite type.

"The figures of Robinson and Holmes and of other workers were then inspected in the light of what information was available as to their mode of origin, and it was evident that soils derived from crystalline rocks in humid temperate climates tend to give a weathering complex with a silica-sesquioxide ratio rather less than 2.0. It may be suggested that samples of such soils, collected without reference to considerations of profile, would probably be enriched in sesquioxides at the expense of eroded superficial horizons. I hope to elaborate this point in its significance for the regional study of soils in a further communication.

Clay Fractions from Alluvial Soils

"An investigation was also made of the clay fractions from a number of soils in which the parent material was alluvium or unconsolidated sediments. In these cases the silica-sesquioxide ratio was always greater than 2.0, the average being actually 2.67 for 15 samples, with the individual ratios varying from 2.12 to 3.37. The published figures of other workers for the clay fractions from alluvial and unconsolidated deposits agree with these results.

"The more siliceous character of the clay fractions of such soils is not difficult to explain. One of the principal features of the hydrolytic decomposition of minerals is desilicification, and this is reflected in the appreciable content of silicic acid in river waters. Sea water, on the other hand, contains only traces of silicic acid. F. W. Clarke, in 'Data of Geochemistry' (*U.S. Geol. Survey Bull.*, 770), places silica among the most important oceanic chemical sediments. The silica-sesquioxide ratio in the estimated contribution of rivers is of the order of 8.0. It is reasonable to suggest that the silicic acid present in river water undergoes precipitation together with estuarine and other littoral deposits, the clay complex of which is thereby enriched in silica relative to sesquioxides. Where these deposits again become exposed to atmospheric influences without intervening heat metamorphism, we obtain soils the clay fractions of which have a silica-sesquioxide greater than 2.0.

A New View

"Summarising these results, I venture to put forward the view that the primary residual product of the chemical weathering of silicates is a mixture of kaolinite and nontronite, or of hydrated silicates having the same silica-sesquioxide ratio, namely, 2.0. Variations from this ratio may occur as a result of the differentiation consequent on soil profile development, leading in humid temperate climates to the production of a more siliceous A horizon and a less siliceous B horizon, and in humid tropical climates to the formation of laterite. Enrichment of the clay complex in silica takes place in estuarine and other littoral sediments owing to the concomitant precipitation of the silicic acid present in river waters.

"The significance of the composition of the clay fraction has been recognised by many workers, notably by A. F. Joseph and his collaborators, who have shown that clay properties are most strongly developed in the most siliceous clays. Hall and Russell, many years ago, attempted to correlate soil fertility with the composition of the clay fraction. It is evident, therefore, that students of the soil are likely to obtain results of the highest importance, both for the natural study of the soil and for the elucidation of problems of soil fertility, by giving attention to the composition of the clay fraction, particularly in its vertical variation in the soil profile."

China Clay Notes and News

Visit of the American Ceramic Society

Arrangements regarding the visit to this country of members of the American Ceramic Society have now been completed. A full account of the arrangements appears in this issue of THE CHEMICAL AGE, p. 561

St. Austell Merchant's Estate

Mr. John de Cressy Treffry, of Penarwyn, St. Blazey, near St. Austell, of the firm of Treffry Clunes and Co., well known in China Clay circles, who died on December 14, 1927, last, left estate of the gross value of £37,025, with net personalty, £29,812. Probate, dated April 4, 1926, has been granted to his widow, Mrs. Mary Beatrice Treffry, of the same address; Ralph Mills Wood, Flint Cottage, Box Hill, Surrey, chartered accountant; and John Cleon Hubbard, of Lloyds Bank Chambers, St. Austell, solicitor. The testator left £50 each to Messrs. Wood and Hubbard as executors, to Amy Evelyn Stewart £320 ordinary stock of the San Paulo Railway Co., Ltd., £26 per annum to his gardener, John Charles Bulley, and the residue of the property to his wife absolutely.

Clay Workers Support Hospital

The report of the St. Austell and District Hospital, read at the recent annual meeting, stated, in regard to the support given by the clay workers to the hospital, that "the sum received from the clay workers and coopers was £388 14s. 6d., as against £427 13s. 10d. the previous year. Taking into consideration the fact that we have passed through one of the most trying times experienced by the clay workers for several years, through numerous works having been closed down for part of the year, the amount subscribed is most satisfactory."

New Sand Separation Patent

B.P. 282,169.—Separation of Sand, Gravel, and Like Substances from Earthy or Loamy Material. H. S. Field, O.B.E., 18, Victoria Street, Westminster, London, S.W., and J. H. Harrison, Maling Street, Newcastle-on-Tyne.—The invention consists in an improved construction of apparatus comprising a container provided with a tubular inlet member at its upper end, for the admission of water containing the raw material, said inlet member extending downward into the container and containing a cone-shaped distributor for the material. Below the outlet of the tubular inlet member is an adjustable annular throat for the admission of an upwardly directed current of clean water and for the evacuation of the heavy particles, which sink down through the current. This throat is formed by a cone mounted axially in the container, and is controlled automatically by means of a float or by hand. The container is provided with an annular overflow channel surrounding the inlet and operating to evacuate the water containing the smaller or lighter particles in suspension, and a conveyor is connected with the container for removing the sand or the like. Further, between the bottom of the container and the casting containing the conveyor an adjustable baffle plate is arranged for preventing the sand over-running the lower part of the conveyor. The materials are introduced into the apparatus carried by or suspended in a large volume of water, which also serves to carry off the waste product or lighter substance. The separating apparatus is arranged so that the rate of flow of the initial and separating liquid can be maintained at not less than that required to maintain the waste product material—that is to say the lighter particles—in suspension, while the current of clean liquid provides a counter-current as referred to at the zone of separation.

Control of Clay Slips

A study is being made of protective colloid action in the casting of clay slips at the Columbus branch of the U.S. Bureau of Standards. Tannic acid and peat have been used to date. The addition of small amounts of tannic acid or peat to slips containing little or no carbonaceous matter, has been found to decrease the amount of water necessary to make up the slips and to increase markedly the cross-breaking strength of inch-bars from such slips. The composition of a typical body containing no organic matter is the following:—

Tennessee Ball Clay No. 7	100	grams
Georgia China Clay No. 4	400	"
Flint	300	"
Feldspar	200	"
Sodium carbonate	1.25	"
Sodium silicate	1.25	"

The addition of 0.2 per cent. carbon in the form of tannic acid or peat (calculated as per cent. of dry weight of body before the addition of water) was found to increase the cross-breaking strength of inch-bars from such slips about 125 per cent., and to decrease by 20–25 per cent. the amount of water necessary to make up the slips. The addition of 0.05 per cent. carbon in the form of peat or tannic acid gave approximately the same cross-breaking strength as the larger (0.2 per cent.) but gave lower water economy. The addition of peat or tannic acid in concentrations considerably greater than 0.2 per cent. decreased the rate of setting of the slips.

The aim in adding protective colloid evidently should be to select such a concentration of protective colloid as will give a large cross-breaking strength of bars and maximum water economy, without abnormally increasing the time of setting. The lower concentrations of peat and tannic acid (0.05 per cent. and 0.2 per cent.) do not decrease the rate of setting of the slip. It is also possible that the addition of protective colloid will aid in preventing the "livering" of slips which have stood for some time.

At the present time, the effect of tannic acid and peat is being tested, using only China Clay, flint and feldspar as the body. Both English and Georgia China Clays are being used.

China Clay Imports for May, 1928

A return showing the quantities and value of China Clay, including China Stone, imported into Great Britain and Northern Ireland as registered in the month of May, 1928, is as follows:—

COUNTRIES WHENCE CONSIGNED.	QUANTITIES.	VALUE.
	Tons.	£
Germany	1	12
U.S. America	60	347
Total	61	£359

China Clay Exports for May, 1928

A return showing the quantities and values of the exports of China Clay, including Cornish or China Stone, the produce of Great Britain and Northern Ireland, from Great Britain and Northern Ireland as registered in the month of May, 1928, is as follows:—

COUNTRY OF DESTINATION.	QUANTITY.	VALUE.
	Tons.	£
Finland	25	105
Estonia	10	30
Sweden	1,757	4,546
Norway	2,062	4,468
Denmark	2	16
Germany	2,150	5,752
Netherlands	2,712	6,032
Belgium	4,649	8,403
France	2,693	4,671
Switzerland	59	193
Portugal	71	210
Madeira	—	8
Spain	2,360	5,284
Italy	1,267	3,797
Bulgaria	1	10
China	16	78
United States of America	29,228	65,903
Brazil	1	3
Uruguay	30	117
Argentine Republic	10	68
Cape of Good Hope	1	14
British India, via Bombay	624	2,562
Via Madras	2	14
Via Bengal, Assam, Bihar and Orissa ..	320	987
Australia	25	203
New Zealand	10	43
Canada	1,951	4,240
Newfoundland and Coast of Labrador	2,063	3,458
Total	54,099	121,287

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay, with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—May, 1928

Arrived.	Name.	Sailed.	Destination
May 1, s.s. <i>Lalita</i>		May 5, Port Ohka	
May 1, s.s. <i>Gouwestroom</i>		May 7, Amsterdam	
May 1, s.s. <i>Joffre Rose</i>		May 4, Rouen	
May 1, s.s. <i>Primrose</i>		May 7, Weston Pt.	
May 2, s.s. <i>Seaforth</i>		May 4, Bristol	
May 2, s.s. <i>Brier Rose</i>		May 4, Plymouth	
May 2, s.v. <i>Vega</i>		May 6, Helsingborg	
May 2, s.s. <i>Ardglass</i>		May 5, Antwerp	
May 2, s.s. <i>Afon Dyfi</i>		May 8, Antwerp	
May 3, s.s. <i>Hampshire Coast</i>		May 8, Liverpool	
May 4, m.s. <i>Muncaster Castle</i>		May 12, New York	
May 4, s.s. <i>Inga</i>		May 21, Gothenburg	
May 5, m.v. <i>Isabel</i>		May 5, Par	
May 5, s.v. <i>Admiral Courbet</i>		May 5, Par	
May 5, s.v. <i>Martha</i>		May 10, Reval	
May 6, s.v. <i>Flying Foam</i>		May 11, Goole	
May 7, s.s. <i>Scheldejol</i>		May 8, Gravelines	
May 8, s.s. <i>Hayle</i>		May 12, Runcorn	
May 9, s.s. <i>Wild Rose</i>		May 12, Bo'ness	
May 9, s.s. <i>Cranley</i>		May 11, Botwood, Nfd	
May 10, s.v. <i>J. H. Barrow</i>		May 10, Looe	
May 10, s.s. <i>Fanny</i>		May 14, Bristol	
May 11, s.s. <i>Joffre Rose</i>		May 12, Preston	
May 11, s.v. <i>Pet</i>		May 24, Glasgow	
May 11, s.s. <i>Jolly Marie</i>		May 12, Guernsey	
May 12, s.s. <i>Blush Rose</i>		May 17, Rouen	
May 13, s.s. <i>Lochaber</i>		May 15, Liverpool	
May 13, s.s. <i>Brier Rose</i>		May 17, Larne	
May 13, m.v. <i>Flying Dutchman</i>		May 16, Harburg	
May 13, s.s. <i>Burrington Coombe</i>		May 15, Bristol	
May 13, s.s. <i>Clan Mackellar</i>		May 17, Bombay	
May 14, s.s. <i>Primrose</i>		May 15, Runcorn	
May 14, s.v. <i>Raymond</i>		*	
May 14, s.s. <i>Avete</i>		May 18, Pasages	
May 15, s.s. <i>Marla</i>		May 16, Harburg	
May 16, s.s. <i>Pylades</i>		May 17, Methil	
May 16, s.s. <i>Ardgarroch</i>		May 19, Antwerp	
May 18, s.s. <i>Haig Rose</i>		May 19, Weston Pt.	
May 18, s.s. <i>Teesbridge</i>		May 24, Philadelphia	
May 18, s.s. <i>Joffre Rose</i>		May 19, Preston	
May 18, s.s. <i>Groningen</i>		May 21, Antwerp	
May 18, s.s. <i>Edith</i>		May 19, Sodertelje	
May 18, s.s. <i>Georg</i>		May 22, Gefle	
May 18, s.s. <i>Eskbridge</i>		May 25, Portland Me.	
May 18, s.s. <i>Alder</i>		May 23, Roscoff	
May 19, s.s. <i>Hayle</i>		May 23, Manchester	
May 20, m.v. <i>Conrad Luhring</i>		May 24, Kotha	
May 20, s.s. <i>Southwell</i>		May 22, Bilbao	
May 21, s.s. <i>Ambleside</i>		May 24, Raumo	
May 21, s.s. <i>Mersey</i>		May 25, Amsterdam	
May 22, s.s. <i>Mersey</i>		May 23, Ridham	
May 22, s.s. <i>Blush Rose</i>		May 25, Weston Pt.	
May 23, s.s. <i>Robrix</i>		May 25, Hull	
May 23, s.s. <i>Marla</i>		May 26, Wiborg	
May 23, s.s. <i>Phaeacian</i>		May 26, Antwerp	
May 23, s.s. <i>Christiansborg</i>		May 31, Portland, Me.	
May 23, m.v. <i>Regina</i>		May 24, Plymouth	
May 23, s.v. <i>C. & F. Nurse</i>		May 29, Greenhithe	
May 23, s.s. <i>Scheldejol</i>		May 25, Gravelines	
May 23, s.s. <i>Trude</i>		May 30, Harburg	
May 24, m.v. <i>Gaelic</i>		May 27, Glasgow	
May 24, s.s. <i>Hampshire Coast</i>		May 26, Liverpool	
May 24, s.s. <i>Brier Rose</i>		May 29, Fleetwood	
May 24, s.s. <i>Jellicoe Rose</i>		May 30, Brussels	
May 24, s.s. <i>Primrose</i>		May 31, Rouen	
May 26, s.v. <i>Lady Rosebery</i>		* Aylesford	
May 26, s.s. <i>Horn</i>		May 30, Santander	
May 27, s.s. <i>Wild Rose</i>		May 31, Runcorn	
May 27, s.s. <i>Mersey</i>		May 30, Ridham	
May 27, s.s. <i>Guelder Rose</i>		May 31, Preston	
May 27, s.s. <i>Joffre Rose</i>		June 1, Bo'ness	
May 31, s.s. <i>Waterton</i>		June 1, South Haven	

Charlestown Shipping—May, 1928

Date.	Vessel.	Destination.
May 2, s.v. <i>Hilda</i>		Rochester
May 2, s.s. <i>Oarsman</i>		London
May 7, s.v. <i>Tarragona</i>		London
May 8, s.v. <i>Isabella</i>		London

May 10, s.s. <i>Weavside</i>	Sunderland
May 15, s.s. <i>Solskin</i>	Tayport
May 16, s.v. <i>Iris</i>	Boulogne
May 17, m.v. <i>Wilhelm Luhring</i>	Aberdeen
May 19, s.s. <i>Brideen</i>	Gravesend
May 19, s.v. <i>Elsa</i>	Nantes
May 21, s.s. <i>Heather Pet</i>	London
May 22, s.v. <i>Lady Jean</i>	Rochester
May 22, s.s. <i>Treleigh</i>	Preston
May 22, s.v. <i>Youngarth</i>	Rochester
May 29, s.s. <i>Ewy</i>	Gothenberg

Par Harbour Shipping—May, 1928

Arrivals.

Date.	Vessel.	From
May 1, s.s. <i>Robrix</i>		Dartmouth
May 2, s.s. <i>Treleigh</i>		Portreath
May 2, s.s. <i>Magrix</i>		Teignmouth
May 4, s.s. <i>Cornish Trader</i>		Charlestown
May 4, m.v. <i>Kate</i>		Falmouth
May 5, m.v. <i>Amiral Courbet</i>		Rouen
May 6, s.v. <i>Waterwitch</i>		Falmouth
May 10, m.v. <i>Mary Jones</i>		Plymouth
May 10, s.s. <i>Enterpriser</i>		Dartmouth
May 11, m.v. <i>Grit</i>		Chichester
May 15, s.s. <i>Pegrix</i>		Penzance
May 16, s.s. <i>Culmore</i>		London
May 17, s.v. <i>Snowflake</i>		Mevagissey
May 18, s.v. <i>Duchess</i>		Mevagissey
May 20, m.v. <i>Maria</i>		Antwerp
May 21, s.s. <i>Cornish Trader</i>		London
May 21, s.v. <i>Isabel</i>		Fowey
May 22, s.s. <i>Reedness</i>		Blyth
May 26, s.v. <i>Lady Agnes</i>		Exmouth
May 31, s.s. <i>Eastoft</i>		Poole
May 31, s.s. <i>Treleigh</i>		Portreath

Sailings

Date.	Vessel.	Destination.
May 2, s.s. <i>Grostenor</i>		Lancaster
May 2, s.s. <i>Robrix</i>		Greenhithe
May 3, m.v. <i>Hero</i>		Garston
May 4, s.s. <i>Treleigh</i>		Weston Point
May 4, s.s. <i>Magrix</i>		Newcastle
May 5, s.s. <i>Cornish Trader</i>		Rouen
May 8, m.v. <i>Kate</i>		Plymouth
May 8, m.v. <i>Amiral Courbet</i>		Paimpol
May 8, s.v. <i>Waterwitch</i>		Runcorn
May 12, s.s. <i>Enterpriser</i>		Queenboro'
May 15, s.v. <i>Grit</i>		Rochester
May 16, s.s. <i>Pegrix</i>		Gravesend
May 17, m.v. <i>Mary Jones</i>		Kirkcaldy
May 18, s.s. <i>Culmore</i>		Rouen
May 22, s.v. <i>Snowflake</i>		Weston Point
May 22, s.s. <i>Cornish Trader</i>		Ternezen
May 23, s.v. <i>Duchess</i>		Weston Point
May 24, m.v. <i>Maria</i>		Rochester
May 25, s.s. <i>Reedness</i>		London

Par Harbour Tide Table, July, 1928

(British Summer Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height
Sunday	1	5.6	5.28	11.5
Monday	2	5.50	6.11	11.7
Tuesday	3	6.31	6.51	11.8
Wednesday	4	7.11	7.30	11.10
Thursday	5	7.49	8.7	11.10
Friday	6	8.25	8.43	11.9
Saturday	7	9.2	9.22	11.8
Sunday	8	9.43	10.4	11.5
Monday	9	10.20	10.49	11.3
Tuesday	10	11.14	11.46	10.11
Wednesday	11	—	0.8	10.9
Thursday	12	0.38	1.11	10.10
Friday	13	1.45	2.20	11.2
Saturday	14	2.56	3.31	11.7
Sunday	15	4.5	4.38	12.2
Monday	16	5.9	5.39	12.8
Tuesday	17	6.8	6.36	12.11

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Wednesday ...	18	7.2	7.27	13.0
Thursday.....	19	7.50	8.11	12.11
Friday.....	20	8.31	8.51	12.8
Saturday.....	21	9.11	9.31	12.3
Sunday.....	22	9.50	10.8	11.8
Monday.....	23	10.27	10.46	11.2
Tuesday.....	24	11.6	11.27	10.6
Wednesday ...	25	11.50	—	10.0
Thursday.....	26	0.16	0.45	9.7
Friday.....	27	1.17	1.52	9.6
Saturday.....	28	2.28	3.3	9.10
Sunday.....	29	3.37	4.9	10.4
Monday.....	30	4.38	5.4	10.11
Tuesday.....	31	5.28	5.51	11.5

E. CLEMENS, Harbour Master.

Penzance Shipping—May, 1928

Arrived.	Name.	From.	Sailed.	Destination.
May 7, s.s. <i>Portland</i>		Killough	May 9,	Rotterdam
May 22, s.s. <i>Penryn</i>		Porthleven	May 25,	Greenhythe

May Deliveries

As the figures below show, the total deliveries made by China Clay firms in May were considerably above those made in April, but the total for the year to date is still substantially below what it was for the corresponding period last year. It is significant that the Ball Clay total is above last year's quantity, and that China Stone is within 2,500 tons of last year's quantity. The two best months of the China Clay year—June and July—have yet to be recorded, and when that time arrives, the margin in favour of last year will probably be overtaken. Details are as follows:—

PORT.	CHINA CLAY.		CHINA STONE.		BALL CLAY.		TOTAL.	
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Falmouth	1,895	505	—	—	—	—	1,895	505
Fowey	63,905	58,954	4,216	5,216	2,882	893	70,803	65,063
Loe	218	—	—	—	—	—	218	—
Par	3,679	4,720	495	1,005	—	—	4,174	5,725
Charlestown	3,894	4,583	—	—	—	—	3,894	4,583
Penzance	620	855	—	—	—	—	620	855
Plymouth...	987	450	—	—	—	—	987	450
By rail	3,976	4,043	—	—	—	—	3,976	4,043
May	78,074	74,110	4,711	6,221	2,882	893	86,567	81,224
4 months	248,549	284,838	16,324	37,519	6,567	7,403	271,540	310,464
5 months	327,523	358,948	21,035	23,740	9,449	8,296	358,007	391,688

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

BROOKSIDE PAPER CO., LTD., Timperley.—Registered May 12, series of £25,000 debentures, present issue £10,500; general charge (not including uncalled capital). *£12,500. August 12, 1927.

HEATH (F.) AND SON (WOODVILLE), LTD., pottery manufacturers. Registered May 2, charge to Bank; charged on Hartshorne Pottery, Woodville.

TAYLOR TUNNICLIFF AND CO., LTD., Hanley, potters.—Registered May 3, £20,000 debenture to District Bank Nominees, Ltd., Spring Gardens, Manchester; general charge. *£30,000. March 1, 1927.

TILEHURST POTTERIES (1922), LTD., Registered May 2, £3,000 debenture to P. E. Harding and another, 5, Coleman Street, E.C.; general charge. *£18,775 18s. 9d. December 22, 1927.

WOODCOTE BRICK AND TILE WORKS, LTD., Registered April 28, charge to Bank; charged on land at Goring Heath. *Nil. December 31, 1927.

Satisfactions

ST. CUTHBERTS PAPER WORKS, LTD., Wells (Som.).—Satisfaction registered May 10, £25,000 part of amount registered September 29, 1926.

SUNDERLAND POTTERY CO., LTD.,—Satisfactions registered April 30, £1,000 registered December 2, 1925 and £560 registered October 28, 1927.

Mining Engineers in Cornwall

Visit to China Clay Works

TOWARDS the end of the last month members of the Institution of Mining and Metallurgy visited St. Dennis and the clay and China Stone works of English China Clays, Ltd.

For the first time in the history of the Institution the members were holding a formal meeting away from London, this being due largely to the initiative of the Cornish Institution of Engineers, who secured the hearty co-operation of the Chamber of Mines, the Royal Institution of Cornwall, the Royal Polytechnic Society, and the Royal Geological Society of Cornwall, and forwarded an invitation to the Institution of Mining and Metallurgy to hold a meeting of its members in Cornwall. The prompt acceptance of the invitation by the Institution was a source of gratification not only to the members of the five Cornish bodies but to all interested in the mining industry of the West Country. This visit should be the means of attracting increased attention to Cornwall's great mineral resources.

On the arrival of the party in the tin mining area, the president of the Cornwall Chamber of Mines, Mr. R. A. Thomas, welcomed the visitors on behalf of the five Cornish Institutions at the Camborne Mining School, and the president of the Cornish Engineers, Mr. Maurice Gregory, responded. Most of the members of the Institution of Mining and Metallurgy stayed at St. Ives and Penzance, but they were entertained in all parts of the mining districts.

English China Clay Works Inspected

On Thursday, May 24, the Institution extended their inspection in Cornwall to the China Clay mining district, a field of considerable contrast to the one to which they had been devoting their attentions. The party numbered about 120, and included the president (Professor S. J. Truscott), and the retiring president (Mr. R. E. Palmer).

The party was met at the top of Hendra Lane, St. Dennis, by Mr. R. Martin, managing director of English China Clays, Ltd., and Mr. A. Davies (works manager). From there the party motored by the Whitmoor Road to the celebrated Dorothy Works. The electrification of the company's system of works was explained, and a visit was paid by some to the winding house, where the operator has charge of two winding lines, which he controls by means of indicators and bells. The main body of visitors was joined at the pit, which affords an excellent example of open workings and of well-regulated operations. Attention was directed to the fine Crossley plant, which is accommodated in a large new concrete building alongside the old stone-built, gaunt "beam" house, and from there the party moved on to the micas and settling pits.

From here the final operations were sketched out, as the flying visit to the area did not permit of a look at the dries. Time remained to those who did not linger at Dorothy works in their interest for a look at Tommy Knights' stone quarry. Here again the orderliness in working was apparent, and the colouring of the stone and the regularity of cutting at the face was noted. At the railway siding close by, to which the stone is trammed, the different types were pointed out by Mr. Martin, Mr. Davies, and the foreman. The visitors were given some details as to the distinct uses to which the stone is put, and were told also of the stone crushing plants.

Outside the quarry the Institution bade farewell to the representatives of English China Clays, Ltd., and departed for Camborne, where arrangements had been made by the tin mining industry for lunch.

China Clay Imports and Exports

THE figures for exports and imports of China Clay arrived too late to be placed in their usual position on this page. They have therefore been placed on page 8.

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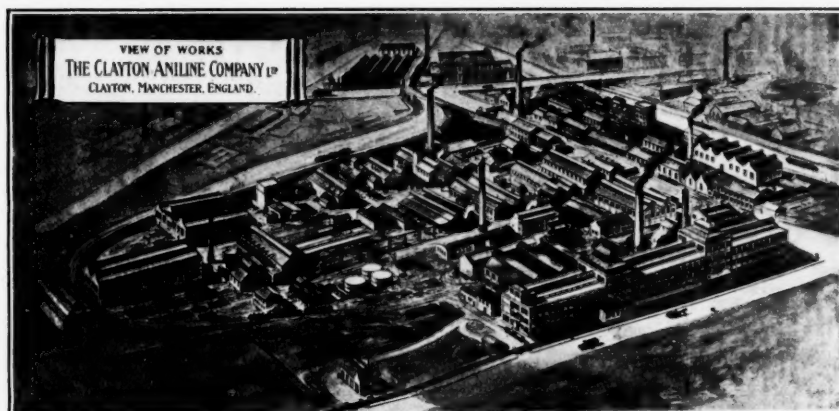
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A Section devoted to the Manufacture and Use of Dyes Published
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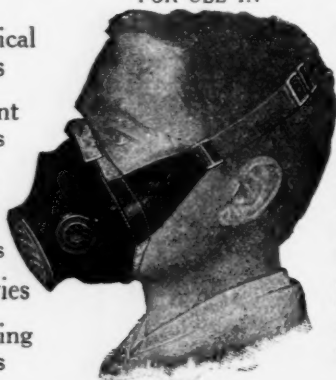
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Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the *Dyestuffs Monthly Supplement* should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

A Dyestuffs Census

THE statistical information relating to dyes and dyestuffs, contained in the Census of Production (1924) for the chemical and allied trades, is of atomic proportions compared with what Mr. Sutcliffe Smith recently suggested or what the United States census actually gives, but it includes a few interesting comparisons. For example, the selling value of British dyes and dyestuffs, which in 1907 was only £821,000, had risen by 1924 to £6,077,000. Coal tar intermediates accounted for £1,174,000 of this amount (200,500 cwts.), finished dyestuffs for £3,950,000 (374,400 cwts.), extracts for dyeing for £155,000 (71,900 cwts), and extracts for tanning for £798,000 (1,316,000 cwts.). In 1907 the selling value of our coal tar dyes was £373,000 (139,000 cwts.). These figures are of little practical value, and the fact that it is 1928 before the 1924 figures are available does not add to it.

Cotton Industry Research

APART from its intrinsic value, which is considerable, the review just published of the work of the British Cotton Industry Research Association, under the title of "Research in the Cotton Industry," has a very distinct personal interest, in that it is a record up to the end of 1926 of the research carried out under the direction of the late Dr. A. W. Crossley. As his successor, Dr. R. H. Pickard, remarks, "the building up of this organisation, characterised by the variety and competence of its staff, the extent of its scientific equipment, and the scope of its library and information bureau, required a tremendous effort. The whole organisation is a constant reminder of the genius of its first director of research, to whom are largely due the results described in the present report and the abundant promise of those to come."

Scientific Study of Faults

A large part of the work of the scientific staff consists of the study of defects and troubles encountered in connection with textile work. About one-quarter of the faults examined have manifested themselves as general unevenness or periodic irregularities in the shade of dyed goods. Perhaps more than any other process, dyeing demands for its successful performance a maximum regularity in all mill and works operations, and it can safely be said that the majority of faults which eventually appear as dyeing defects originate at some earlier stage. Unsuitable raw cotton, irregularities in the counts or twists of yarns, variations in sizing or weaving, improper treatment of cloth for the removal of stains, inefficient desizing, insufficient boiling, over-bleaching and irregular mercerisation have all been definitely traced as sources of dyeing defects submitted for examination by members. Thus every branch of the industry, even from the cotton grower, can still contribute to the production of more perfect dyed goods, and it is to this end that the advantages of the great variety of experience, methods, and technique at the Association's disposal become most evident.

"Dead" Cotton Effects

No example has yet been encountered in which the mixing of different marks or varieties of cotton during the spinning process has resulted in unlevel dyeing, but among the defects

submitted, a certain number have been traced to the mixture, in manufactured goods, of yarns spun from different varieties, and methods of identification described in Chapter I. of the report have proved extremely valuable in establishing this source of irregularity. The commonest dyeing defect which can be traced back to the raw material is due to the presence of "dead" or immature cotton, and very many such examples have been received and diagnosed. It is now possible to determine with certainty, from microscopical and chemical examination, whether a dyeing fault is or is not due to the presence of "dead" cotton. The use of certain dyes or of certain finishing processes greatly reduces the unfavourable dyeing properties of dead cotton, but the necessity imposed upon the dyer of working to price, shade, and finish generally renders it impossible for him to cover the defect. The only remedy then lies in improving the quality of the raw material or increasing the efficiency of spinning. It may be of interest to note that the Association's records show a periodic recrudescence of "dead" cotton defects in the spring and autumn months.

Another trouble which goes back to the bale is the presence of an undue amount of fuzz, and just as the thin-walled "dead" cotton usually appears in the form of light specks, the thick-walled fuzz appears in the form of dark specks.

Effects of Mercerisation

One of the commonest sources of dyeing faults is undoubtedly the mercerisation process. Very many examples have been investigated, particularly for the hosiery trade, in which variations occurring during hank mercerisation have resulted in abrupt changes in shade. It is usually possible to establish mercerisation as the source of the trouble, but it is often extremely difficult to locate the exact point at which the defect arises. At present, it can only be said that yarn mercerisation is among the most difficult of processes to control, that very slight variations in conditions have a serious effect on subsequent dyeing, and that manufacturers would be well advised to make certain that different batches of mercerised yarn are never mixed in the same goods.

Steaming and Ageing

THE proper fixation of colour produced by steaming and ageing is considered by modern authorities to depend on the mutual relations between the cotton, the water supplied as steam, and the dye materials. Therefore, a study of the absorption of water by cotton at high temperatures is a necessary preliminary to an adequate understanding of the steaming and ageing processes. Such an investigation has shown that maximum absorption of water and maximum swelling occur at 100°C. and 100 per cent. relative humidity, and it would appear, therefore, that these are the ideal conditions for such a process. Actually, the humidity cannot be allowed quite to reach 100 per cent. if condensation, and all the troubles that come with it, are to be avoided.

Experience in the control of conditions in the steamer or ager has convinced the trade that one difficulty in the way of progress is the lack of any reliable thermometer. The ordinary commercial form of electrical thermometer has too great a time-lag to follow the rapid fluctuations of

temperature which occur normally whilst a succession of pieces is going through the ager. An electrical thermometer with quite negligible lag has therefore been constructed in the laboratories and is being used to study ager temperatures.

Action of Intense Light on Cotton

It is well known that intense tropical light tenders cotton goods to an extent which considerably reduces their useful life. Whilst this action may be ignored with most classes of goods, it becomes of great importance with aircraft and other fabrics subject to continuous outdoor exposure.

An investigation, in which both powerful artificial sources of light (the mercury and carbon arcs) and sunlight in England and abroad have been employed, has shown that cotton yarns become more resistant to light as the yarn becomes coarser and as the twist is increased. Mercerisation of yarn and cloth is slightly advantageous, but scouring and bleaching produce a rather less resistant product.

In attempting to find a treatment which would reduce the light sensitivity of cotton, it has been shown that generally direct and vat dyes have very little influence on the rate of tendering, while many basic dyes actually increase the sensitivity. Other treatments which have been tested are, however, capable of protecting cotton exposed to intense light to such an extent that the life of the material is prolonged three or four times.

"Acetate Silk and its Dyes"

THE volume on *Acetate Silks and Its Dyes*, by Mr. Charles E. Mullin, a well-known American chemist, published by Constable and Co. (pp. 473, 26s.) contains a comprehensive and practical treatment of the whole subject, and useful patent, name, and subject indexes. As Dr. Louis A. Olney, Professor of Chemistry and Dyeing at the Lowell Textile School, remarks in the course of an introductory note, the extensive commercial use of the acetate silks was somewhat delayed owing to the difficulties at first experienced in producing upon them full dyeings and fast colours. Failures in this respect were simply the natural consequence of attempts made to apply to these acetate silks the same dyes by the same methods that had formerly been found so satisfactory with the regenerated cellulose silks which were so readily dyed by practically all of the methods used for the dyeing of cotton. It was not until the marked difference between the dyeing properties of cellulose acetate and cotton were fully appreciated, and dye chemists recognised the fact that entirely new dyes and dyeing processes might have to be devised, that any great headway was made toward the satisfactory dyeing of acetate silk.

Five Years' Progress

THE last five years have witnessed remarkable developments in this respect, and many dyes of entirely new molecular structure, as well as new processes of application, have been devised to overcome obstacles that at one time threatened disaster to the future of the acetate silk industry. It is doubtful if any of the many remarkable developments made in connection with colour chemistry and dyestuff application illustrate more vividly the ability of the textile and colour chemist to contend with the most puzzling of problems, when the exigency arises. Notwithstanding the remarkable developments that have been made in the dyeing of acetate silk, there is still much work to be done in order that the dyer may be able to colour this fibre with the same ease, flexibility, and wide range of colours that may so easily be applied to cotton.

A Useful Reference Book

IN this volume, Mr. Mullin has presented, in a comprehensive manner, the history of the remarkable development of acetate silk dyeing, and has described with detail the processes which are now in use for this purpose. While

much of the material presented is necessarily a record of the work of other investigators, the author has frequently introduced with advantage the results of his own investigation and specialised knowledge. Being a thoroughly trained textile chemist, familiar with the underlying principles of the subject, he has avoided the vagueness of expression and technical ambiguities that often appear in books of this character. To all interested in the dyeing of cellulose acetate silk, this book should be found useful as a work of reference.

Dyeing Schools in India

INSTRUCTION in dyeing and bleaching is given at the Government Dyeing School operated at Shadara, India. Since the opening of a model dyeing plant the course has provided theoretical instruction and practical training under actual mill conditions. A research laboratory is maintained in conjunction with the school, and a calico printing section has recently been added. The institution has turned out from 1916 to 1925 more than 300 students trained in the art of dyeing.

The dyeing industry in the United Provinces is also making progress. Some of the large dye-houses at Cawnpore have been considerably extended and improved recently. Progress in printing, especially in block cutting at Furukhabad, is maintained, and at Muttra a calico-printing factory of multi-colours has been started. The printing industry at Lucknow, however, shows decline. With a view to assisting the industry at Lucknow, it has been decided to start a dyeing and printing school at Bulandshahr. By conducting a large number of demonstrations, the skilled use of fast colours has been considerably popularized.

Dyestuff Consolidation in U.S.A.

AN interesting consolidation of dyestuff manufacturers under the corporate title of "Chemical and Dye Corporation" is announced from the United States. The constituent companies are the Chemical Co. of America, of Springfield, N.J., the New England Aniline Works, of Ashland, Mass., and the Tower Manufacturing Co. (dyestuff department), of Newark, N.J. It is the intention of the new corporation to merge all manufacturing operations in one plant, to be located at Springfield as rapidly as the necessary transportation of apparatus, etc., can be accomplished. The selling and executive offices of the new corporation will also be located there. The Chemical and Dye Corporation will continue to manufacture the various types of dyestuffs which have heretofore been produced by the three companies, and will also add to this line, as rapidly as possible, new products for which the experimental work has been already carried out. The operation of the new corporation will be under the direction of executives who have been in charge of the above-mentioned three companies in the past. The step is generally approved as indicating closer co-operation in both manufacture and selling on the part of the smaller dyestuff manufacturing concerns.

Chinese Imports of Aniline Dyes Lower

AN outstanding feature of the aniline dye trade during 1925 in China was the liquidation of the less popular "chops" of sulphur black stocks by the syndicate of German firms in China, with the intention of future concentration on the best known and more popular qualities. Aniline dyes to a total value of \$2,643,392 were imported during 1926, as against \$3,240,277 in 1925. The largest part of the dyes credited to the Netherlands, Hongkong, and Belgium are undoubtedly of German origin and should be kept in mind when considering Germany's participation in this trade. Despite all the difficulties arising from civil war, and violent fluctuations in Chinese currency, the importation of aniline dyes during 1926 remained about the same as in 1925.

Colour Swatches: How to Make Them in Your Own Works

In a bulletin issued by the Hillsborough Mills, Wilton, N.H., an illustrated account is given of a mechanical means of producing colour swatches, which has many advantages over hand methods.

In the woollen and worsted industries a large number of pads or swatches of carded and felted material are being made continuously. In many cases they are made by hand in a slow and unsatisfactory manner. In accordance with modern tendencies, a machine has now been made available which will make these pads in a far quicker and more uniform manner than has been possible before.

This efficient machine is fully illustrated in Fig. 1. and Fig. 5. Fig. 5 (B), is a stationary ring into which a roughly shaped dry pad of the material to be felted is placed. This ring is adjusted so as to bear lightly but firmly on the rubber covered plate A. The plate is held on the end of a vertical crank pin so that it rubs with an oscillating motion on the bottom of the ring, being free also to revolve. A small amount of soap solution

to see that the rubber disc has not stuck to the bottom of the cylinder. Place the roughly shaped dry pad of the material to be felted into the cylinder and put weight C on it. Start

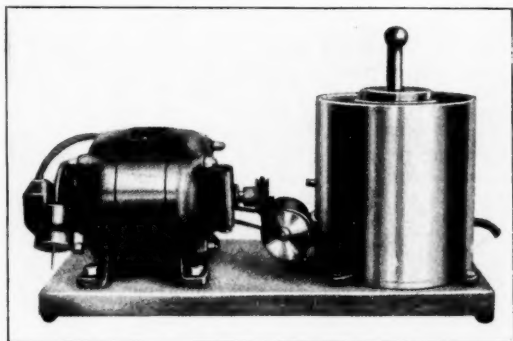


FIG. 1.

is poured into the ring and the dry pad put in with the weight C on top. The rubbing action of the rubber covered plate together with the pressure rapidly forms a well felted pad of uniform diameter and thickness.

Compared to the usual hand method, these machine-made pads are of uniform thickness, size, and weight, whereas the hand ones are almost impossible to make round and are invariably thicker in the centre, requiring much more material.

In addition to making a far better product this pad machine saves its cost many times over in labour. The machine can do the work of from three to four men so that the time of several men can often be saved, or one man can make all the samples in his spare time, where a man's whole time was formerly required.

Practical Details

Now as to practical instructions. Take Fig. 4. Screw the hand card holders on to a steady bench as shown, placing at a convenient height and distance from the edge. Set one of the hand cards in the holder with the handle pointed away from you. Take about one gram or 15 grains of stock cut to three-quarter inch lengths. A Torsion Balance No. 269 with scale of one gram divided into 100 parts is found very convenient to weigh off percentage mixtures. Dab this stock on along the bottom of the card. Take the loose card and start teasing out the bunches with the upper end, gradually working up on the fixed card until you are working across the whole face.

Take up the fixed card and with the handles together scrub one card on the other until the stock rolls off in a long sliver-like shape as shown in Fig. 2. Do this several times for a mix. Then fold the long sliver into a hairpin shape. Roll this into a disc-shaped mass as illustrated at the right in Fig. 2 and put into the perforated metal ring. Pound several times with the small wood plunger. Push the pad into the other end of the cylinder with the plunger and pound again several times. You now have a uniform dry pad ready for the felting operation.

The Felting Process

Now turn to Fig. 5. Pour a small amount of liquid soap into cylinder B. Turn the motor over a few times by hand

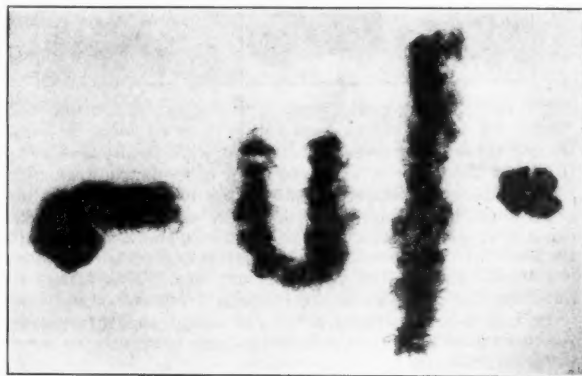


FIG. 2.

the motor. The felting action begins at once and is completed in a few minutes, depending on the character of the wool.

Take out the pad and examine it. If not felted as smoothly as desired, turn it over and continue the felting further. The rubbing action of the rubber covered plate, together with the pressure, rapidly forms a well felted pad of uniform diameter and thickness.

When this is satisfactory, pour a small amount of warm water over the weight so that it runs down into the cylinder. This hardens up the pad to some extent. After removing the pad, flush the ring and weight with warm water to remove all soap and lint, which drains away through pipe D in a drain or sink.

The next step is to wash the soap out of the pad. This is done by placing the pad in the strainer, Fig. 4. Hold the pad under a stream of warm water strong enough to drive through, but not enough to open up the material. Turn the

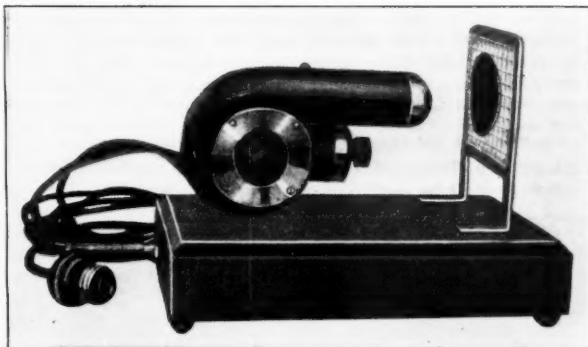


FIG. 3.

pad over several times to make certain all soap is removed, otherwise the soap will show on the surface as a white or yellow film which will affect the shade seriously.

Drying

Press out the surplus water by passing the pad through a wringer or blotting on a towel. Place the pad in the centre of the wire screen opposite the blower (Fig. 3) and turn on the hot air. There is sufficient pressure from this jet of warm air to hold the pad in place on the screen, driving the air through and completing the drying in three or four minutes.

Drying pads in an oven or over steam coils takes fifteen to

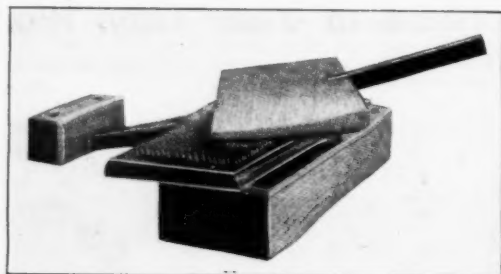


FIG. 4.

twenty minutes, and then does not dry uniformly and is apt to yellow the shade. A vigorous flow of moderately warm air from this blower dries quickly and uniformly and does not yellow.

Some colours change quite markedly when heated or over-dried, so it is often of advantage to turn off the heat by turning the switch to the second notch and running on cold air for a few minutes when the pad is nearly dry. This brings the humidity back to that of the room in a minute or so.

In Fig. 6 is illustrated a typical set-up and arrangement which enables the work to be done very efficiently as everything necessary is quickly available.

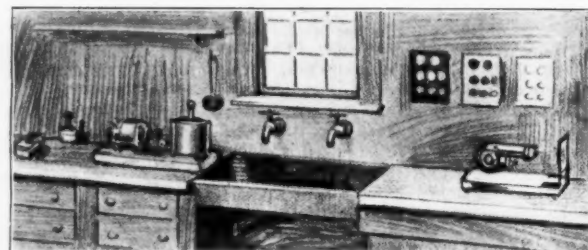


FIG. 6.

In Fig. 7 is shown a range of a single colour dyed in 0.1 per cent. ranges, from 0.05 to 1.5 per cent., very convenient in matching new shades. The pads are easily made and matched. The card can be filed alphabetically under its colour or by a serial number, using a card index to locate.

In making permanent records of dyed or mixed lots, the pads are of such size that they can be readily attached to a 3 by 5 inch file card with the formula and other records of the lot (Fig. 8). These cards can be filed in a regular standard file drawer or box. A great help in locating colours is to cross-index the cards by colours. Red B would, for example, be the title of one of the cross-index cards. At the back of this would be Red E, Red G, etc. These would be followed by cards such as Red B, Blue B, Red B, Yellow G, etc., each card

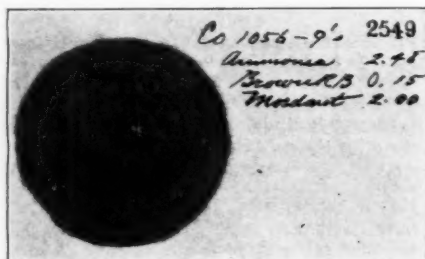


FIG. 8.

How Pads are Used

The pads formed in the manner just described are used to great advantage in many textile departments. For example, the mixing department in a woollen mill can easily make up sample or experimental mixtures, as well as taking samples for examination and record of the lots in process. The same is true in the mixing rooms of worsted mills to make up the large range of colour mixtures required by the modern trade.

The dyer can take samples from his kettles and make up well-dried, evenly felted pads, which can be accurately compared with his standard or with previous lots. The pads can be made so quickly and easily that it is quite practical to keep track of the progress of the dyeing of a kettle by taking pads at frequent intervals and clipping them on a file card.

Six pads from a dyehouse record will serve to show the

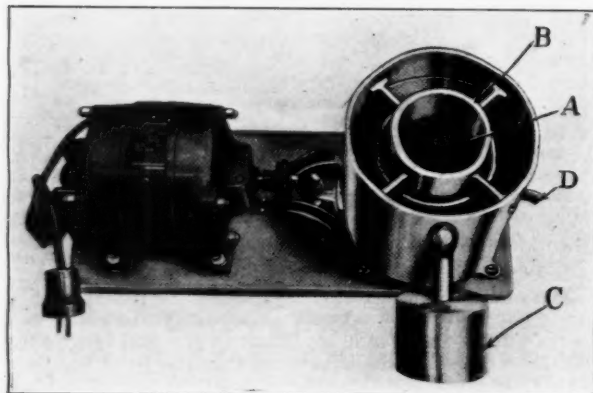


FIG. 5.

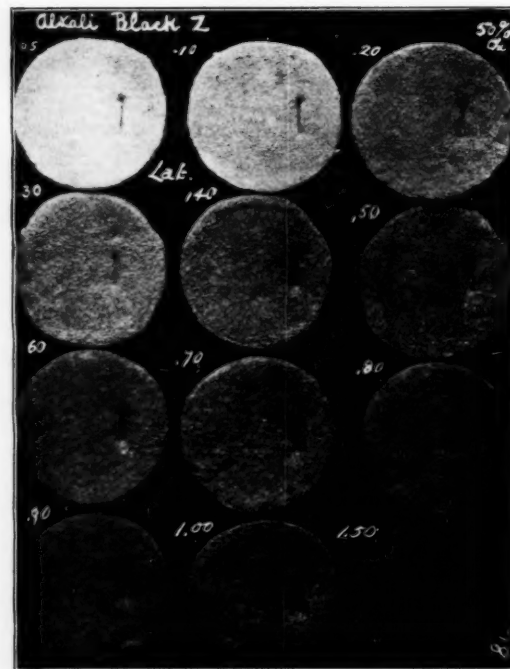


FIG. 7.—A RANGE OF A SINGLE COLOUR DYED IN 0.1 per CENT. RANGES FROM 0.05 TO 1.5 PER CENT.

showing the percentage of colour. With an index of this character, any colour or any combinations of colours previously dyed can at once be located. A large amount of easily available dye information can then be put into a small space, while the colours are available for eye selection if desired.

By using a wire stapling machine pads can be conveniently

clipped on to any sort of card. Another extensive use for well felted pads is in sample lines of textile salesmen. A large number of samples on marked cards can be conveniently carried. The same advantages can be secured by the dye salesmen.

Except where the customer required the colour on yarn or piece dyes, almost all colours could be shown to much greater advantage on a pad uniform in size and surface. Once uniform easily-made pads are made available, the busy mill man will constantly find many new uses for them.

Dyes and Their Application: Technical Progress in 1927

By L. J. Hooley

The author, who regularly keeps readers of this journal informed of progress in dyestuff chemistry, here begins a comprehensive review of the advances made in 1927. The review will be concluded in the next issue of this supplement.

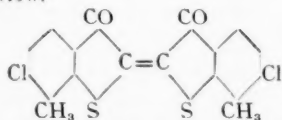
Now that the recently established dyestuff industries both of this country and abroad, have had time to perfect their establishments and processes of manufacture to meet practically the whole of the consumers' immediate requirements, their research staffs are able to devote an increasing proportion of their time to newer developments. At the same time the German and Swiss industries are pursuing their investigations in new directions with their accustomed vigour. As a result the industry, as a whole, has a large volume of interesting research work to show for the past year.

The same tendencies which have been apparent for the last two or three years are still to be seen, and the manufacturers are striving not only for products which are faster, but also purer, brighter, and easier to handle and apply. The various colour series are being thoroughly overhauled, and the most satisfactory members developed.

The relative attention devoted to the various classes is roughly as follows: The many different azo colours account for nearly one-third of the whole, the anthraquinone, indigo and other vat colours with their related compounds for a similar proportion, leaving the residue to the large number of other less important groups. The most significant developments in each branch are briefly considered below, British and foreign work being considered together.

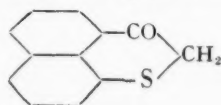
Indigoid Dyes

In the indigo series attention is focussed on the synthesis of dyes which come nearest to the anthracene vat colours. By substitution in the very brilliant, but not very fast thioindigos, great improvement in fastness to light, washing and kier boiling has been effected with little loss in brightness. Some of the indigos are now included in the Indanthrene series, especially where there is great brightness to set off any defects. As the thioindigo products offer more scope at the red end of the spectrum, these colours are found to predominate in the newly described substances. The substituted bis-thionaphthene indigos give shades from red to violet. They are prepared (a) by direct halogenation of the thioindigos as in E.P. 254,340 and 254,734 (I.G.F.A.-G.) and (b) by condensation or oxidation of already substituted oxythionaphthenes and thioisatins as in E.P. 251,996, 271,906 (I.G.F.A.-G.), E.P. 267,177 (S.C.I.B.). Thus 6-chlor-7-methyl oxythionaphthene on oxidation gives a carmine red-colour shown below.



From mixed indigos of, for example, the thionaphthene-indole indigo type, shades outside the above red to violet range can be obtained; thus 4:5:6:7-tetrachlor thioindoxyl with 5:7-dichlor isatin gives a brown, E.P. 262,457, 274,527 and G.P. Appln.C. 35,654 (I.G.F.A.-G.); C. 38,883 (Cassella).

The *peri* naphthoxy-penthiophenes have recently been utilised, being condensed both with nitrogen and sulphur constituents to give blue to green shades, E.P. 275,292



peri NAPHTHOXY-PENTHIOPHENE

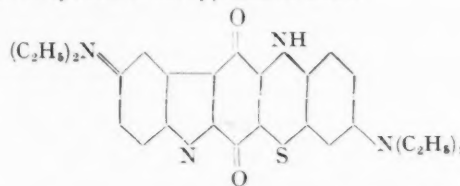
(I.G.F.A.-G.), A.P. 1,613,275 (Grasselli). The Swiss firms have placed some of the anthracene indigos on the market.

The Chemische Fabrik auf Actien have described halogenated oxindol-3-acetic acids for pharmaceutical purposes. Of theoretical interest are: the unsuccessful attempt of Overmyer to prepare a hexamethoxy indigo starting from gallic acid; the new thiopyrindigo described by Koenigs and Kantrovitz (*Ber.*, 1927, Vol. 60, 2,097); the determination by Wahl and Fericean (*Comptes Rendus*, 1927, 106), of the constitution of the disulphysatide obtained by Laurent in 1841 from isatin and sulphuretted hydrogen; and the indigo respiration model of Kunz and Kiess (*Ber.*, 1927, 267) already dealt with in the DYESTUFFS SUPPLEMENT for March.

Sulphur Colours

Interest in the sulphur colours is mainly in improvements of the more important dyestuffs, especially the blacks, which are used in enormous quantities. In America alone in 1925 the consumption of sulphur blacks was upwards of fifteen million pounds, so that a new black with better properties than the current market ones has great sale possibilities in front of it. Continuous attempts are being made to remove the disadvantages which separate the sulphur blacks from aniline black, such as the tendering of the fibre, and the susceptibility to change on bleeding. As blacks are used in much deeper shades than other colours, their fastness to washing and light is correspondingly improved, but the large quantity of dyestuff which is put on to the fibre is a disadvantage in tendering. Vidal, from his work on oils, claims to have discovered an agent which by eliminating the sulphur deposited on the fibre removes the possibility of sulphuric acid forming, and at the same time gives fuller shades which are stated to be an efficient substitute for aniline black. In preparing the dinitrophenol blacks, by thionating the sodium salt, using a particular poly-sulphide and sulphur mixture, Paley (A.P. 1,598,303) obtains 20 per cent. higher yields and a richer colour. The two recent Indocarbons, CL and SN, are meeting with increasing recognition, as they remove some of the objections of the yarn dyer to sulphur blacks.

Among modifications in carrying out the sulphur melt there is the use of copper as the cuprocyanide, A.P. 1,609,927 (I.G.F.A.-G.), and the addition of urea and other bases in the sulphurisation of the indo phenols (S.C.I.B., E.P., 270,348). The indophenols from carbazole derivatives and *p*-nitroso phenol are obtained in purer form by the use of low temperatures (Du Pont, A.P. 1,628,534 and 1,637,868). Cassella describes new intermediates for sulphur and other dyes from sulphur chloride and arylamines (E.P. 265,498 and 265,641). Shibata (*J.C.S.I.*, Japan, 1927, Vol. 30, 121 F) has synthesised a blue vat dyestuff of the type shown below.



The mention of aniline black a little further back recalls the death, during the year, of Prud'homme.

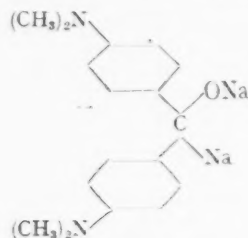
Basic Colours

While considerable theoretical investigation has been done on the azines, dinaphthoxazines, carbazines, fluorindenes, etc., by the Swiss school, and on the xanthenes by Dhar and Dutt, who have synthesised citraconeins and itaconeins, practical work has been almost at a standstill except for a little on the production of tannin substitutes and of basic pigments.

Lantz and Wahl (*Chem. Abs.*, 20, 1992) have carried out a new synthesis of phenylrosinduline from 2-hydroxy 1,4-diphenylimino-naphthoquinone and aniline with zinc chloride, and Geigy's have obtained greenish-blue acid dyes by condensing isorosinduline sulphonic acids with N-alkyl *p*-phenylenediamine (E.P. 265,986).

Triarylmethane Dyes

The British Dyestuffs Corporation have protected a new reaction for the production of triarylmethanes from diaryl ketones such as Michler's ketone, combining the ketone with sodium and then reacting on the sodium compound formed with an aromatic halide. The two stages may be combined, thus Michler's ketone with sodium and chlorobenzene gives Malachite Green (B.D.C., Rodd, E. H., and Linch, F. W., E.P. 272,321).



Anthraquinone Series

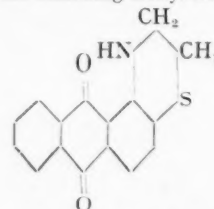
Owing to the expensive nature of the starting substances in this series, economy in production is of great importance, and a careful choice of route is necessary in preparing a compound which necessitates several intermediates; consequently the discovery of an improved process for any one may result in considerable alterations in the preparation of others. The significance of many of the results in this group depends on points of detail and only some of the most typical results are given. The simpler bodies will be dealt with first.

The reduction of anthraquinone derivatives to the corresponding anthracenes does not generally take place very readily, and much less easily than the formation of the leuco bodies. In B.P. 260,000 an anthraquinone derivative is sublimed into a stream of hydrogen passing through a tube containing copper or zinc dust (I.G.F.A.). Anthracene may be oxidised to anthraquinone with air at about 475° C., using a catalyst consisting of 89 per cent. of uranium oxide and 11 per cent. of molybdenum oxide (Barrett Co., A.P. 1,363,856); it may also be oxidised electrolytically in sulphuric acid with a special catalyst prepared from cerite (E.P. 265,672. Field and Dwen).

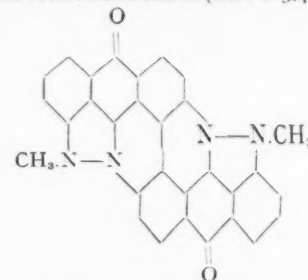
The sulphonation of anthraquinone has been dealt with exhaustively by H. E. Fierz-David in *Helvetica Chimica Acta*. Anthraquinone sulphonic acids can be obtained from chlor benzoyl benzoic acid, by first replacing the chlorine using a sulphite, and then ring-closing the resulting sulpho-benzoyl benzoic acid (E.P. 273,347. S.D.L., Thomas, J., and Drescher, H. A. E.). Sulphonic acid groups may be removed electrolytically (E.P. 273,043. B.D.C., and Hailwood, A. J.). The Newport Chemical Co. prepare 2-chlor-quinizarine from a new intermediate, 3,4-dichlor phenol, which is condensed with phthalic anhydride in the presence of sulphuric and boric acids (E.P. 260,554). α -Amino groups may be replaced by hydroxy groups by hot alkaline reduction, thus 4:8-diamino anthrarufin can be converted to 1:4:5:8-tetrahydroxy anthraquinone. The British Dyestuffs Corporation, in a series of patents, prepare leuco 1:4-diamino anthraquinone and its derivatives from quinizarine and similar substances, and convert the resulting leuco body directly to 1:4-diamino-2:3-dichlor anthraquinone, 1:4-dibenzoyl diamino anthraquinone (Algol Red 5G), etc. (E.P. 268,891, 270,798-9. B.D.C., Shepherdson, A., Tatum, W. W., Bunbury, H. M.). The diazotisation of a diamino body is often difficult to control when only one amino group is required to be treated. The sulphonic acids of 1:4-diamino anthraquinone only give mono-diazo derivatives even with excess of nitrous acid. They may be used for making dyestuffs of the type of Direct Blue A, after replacing the diazo group with halogen (E.P. 264,879. I.G.F.A.-G.).

Anthraquinone-*o*-amino mercaptans may be condensed with ethylene bromide to give ω -brom methyl thiohydriins, these

on heating at 100° C. ring-close to thiomorpholines, which which may be used for colouring acetyl silk.



Red vat dyes are obtained by the alkylation of the alkali fusion product of pyrazolanthrone. In A.P. 1,627,738 yellow products are got by treatment with formaldehyde in sulphuric acid (Grasselli). Red dyes are also obtained by alkylating the pyrazolanthrone before alkali fusion (E.P. 265,494. I.G.F.A.-G.).



The constitution of the products is not known with certainty, but that of the first mentioned red body is probably shown in the formula above. Flavanthrone has been synthesised from anthraquinone 1-chlor 2-urethane, which is converted to the dianthraquinonyl and this on heating alone or with a substance such as sulphuric acid passes over into flavanthrone. The two stages may be combined (E.P. 278,039. S.D.L., Smith, W., Thomas, J.). 1-Nitro anthraquinone-8-sulphonic acid on reduction in neutral or alkaline solution with insufficient alkali for complete reduction of the nitro group gives the hydroxylamine, which with caustic alkali passes over to indanthrone disulphonic acid (E.P. 274,226. B.D.C., Shepherdson, A., and Hailwood, A. J.).

The amino anthraquinone obtained from 4¹-substituted 3¹-amino 2-benzoyl benzoic acids by cyclisation with sulphuric acid can be separated into two isomers. When the constituent is chlorine the isomers are 1-amino-2-chlor anthraquinone and 2-amino-3-chlor anthraquinone (E.P. 264,916. S.D.L., Drescher, H. A. E., Smith, W., and Thomas, J.). These are valuable intermediates. Thus the first mentioned can be condensed to a blue vat dyestuff (E.P. 268,537. S.D.L., Woodcock, W. G., Drescher, H. A. E., Beckett, E. G., and Thomas, J.). Bromination gives the corresponding 1:2:3 and 1:2:4 derivatives, and these may be condensed with amines (e.g., E.P. 278,417. S.D.L., Hooley, L. J., and Thomas, J.). The golden yellow shade of pyranthrone may be deepened to red or reddish brown by oxidising and alkylating (E.P. 278,102. B.D.C., Shepherdson, A., and Hailwood, J.).

There has been a revival of interest in the acid wool blues. The British Dyestuffs Corporation have obtained a bright violet with 4-*p*-toluidio 1-hydroxy anthraquinone 2-sulphonic acid, and a red blue with the corresponding 4-*p*-toluene sulphonamide (E.P. 268,542, 275,421. B.D.C., Shepherdson, A., and Tatum, W. W.).

Benzanthrone Derivatives

It is very satisfactory to record the publication of new results in this field by the British Dyestuffs Corporation, Scottish Dyes, the British Alizarine Co., and L. B. Holliday, and in addition Brotherton's have commenced manufacture. This work covers new direct blacks and modifications in the blue and violet dyes, as well as some improved methods of preparation. In the wider region of new syntheses Scottish Dyes also have several recent patents to their credit. The I.G.F.A.-G. are examining the benzanthrone with great thoroughness. As this class was dealt with in the December issue of the DYESTUFFS SUPPLEMENT, the matter will not be treated further here.

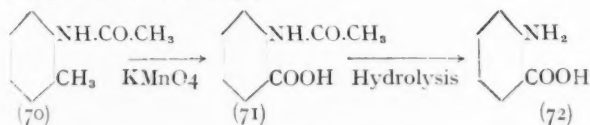
(To be concluded.)

Basic Intermediates for Dyestuffs: No. XIV.—Further Derivatives of Benzoic Acid

By "Consultant"

AMONG the amino derivatives of benzoic acid the simple ortho compound, anthranilic acid, is by far the most important, and although the meta and para derivatives find a limited use in the manufacture of therapeutic compounds (notably the local anæsthetic esters of *p*-aminobenzoic acid), they are of little use in the dyestuffs industry. The principal use of anthranilic acid is as an intermediate step in the preparation of indigo, and the successful preparation in good yield of anthranilic acid contributes considerably to the economic synthesis of that dye. Some anthranilic acid is also used in the preparation of indranthrene colours, such as the violets, and also, of course, in the preparation of certain thioindigo dyes.

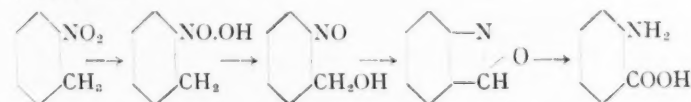
Even if benzoic acid was a cheap intermediate, its nitration and reduction to the orthoamino compound is not possible, since the carboxyl group is a meta directing group, so that alternative methods have had to be devised for its preparation. Many of these are more of academic than of industrial interest, as for example the oxidation of acet-*o*-toluidide (70) with sodium permanganate and subsequent hydrolysis of the acetyl anthranilic acid (71)



to anthranilic acid (72). The process has been worked on a semi-commercial scale, but it is very doubtful if it could ever become commercially valuable. The main features of the process are as follows:—

The acet-*o*-toluidide (15 lb.) is dissolved in hot water (350 galls.) at 80° C., together with crystalline magnesium sulphate (30 lb.). After about half an hour's stirring this should give a clear solution, at which point sodium permanganate (20 lb.) is added, stirring being continued vigorously. The temperature rises to 85° C. and remains there for some time while oxidation takes place. As soon as the temperature shows signs of falling, a further 10 lb. of the permanganate is added and later a second portion of the same size, making 40 lb. in all. Stirring is continued for an hour after the addition of the permanganate, by which time all of the latter will have disappeared. The solution is filtered hot, the press cake slightly washed with hot water, and the united liquors acidified with hydrochloric acid. On cooling, acetyl anthranilic acid separates out as a sandy powder, and is hydrolysed to the acid by boiling dilute alkali. The disadvantages of the process, *i.e.*, the costly raw material, the virtual loss of acetic acid, and the high price of permanganate oxidation (even allowing for recovered manganese), are sufficiently obvious.

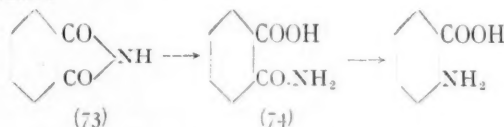
Another little-used process, but one which might conceivably be valuable in the event of a demand for paranitrotoluene, or of a sharp drop in the price of toluene, is that which involves the rearrangement of orthonitro-toluene by boiling with alkali and later with a mild reducing agent. The reaction has been represented by Scholl (*Monatshefte*, Vol. 34, 1,011 (1913)) thus:—



The exact course of the reaction is a matter for conjecture, although the above series of changes is very plausible. In actual practice the change is conducted thus. The orthonitrotoluene (1 cwt.), is boiled in an enamelled digester with caustic soda (98 per cent., 1 cwt.) and alcohol (110 galls.). The reaction is considered to be completed when a sample of the liquid no longer smells of the nitrotoluene. The reaction mixture is cooled to ordinary temperature, saturated first with ammonia and then with hydrogen sulphide, and again heated to boiling to complete the process. The whole is then

rapidly evaporated to dryness under partial vacuum and the residue extracted with water, after which the extract is acidified with hydrochloric acid. The anthranilic acid separates after a few hours almost completely, and may be filtered off, washed, and dried in the usual way. Thus prepared it has a melting point of 143-144° C.

The most favoured process, however, for the preparation of this intermediate is a modified form of the Hofmann reaction, in which phthalamic acid, or rather its sodium salt, plays the part of the acid amide. Phthalamic acid (74) is readily obtained

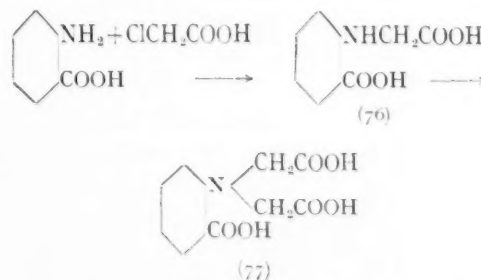


by the action of alkali on phthalimide (73), the preparation of which has been dealt with in a previous article. The reagent used to effect the Hofmann change is sodium hypochlorite. For this purpose it is prepared in the following way. Caustic soda (98 per cent., 3 cwt.) is dissolved in water (75 galls.), and saturated with chlorine in the cold. This requires about 140 lb. of chlorine. The solution is stirred well, and to it is added finely ground phthalimide (4½ cwt.). This mixture is stirred until solution is almost complete, at which point the filtered solution is transferred to another vessel and saturated with sulphur dioxide to destroy any excess of the reagent. On the addition of hydrochloric acid (about 5½ cwt.) anthranilic acid separates as a yellow-brown sandy powder.

p-Diethylaminobenzoic acid.—A small quantity of this acid is still prepared for the manufacture of dyes such as Acid Violet 4B, which require the acid chloride, obtained from the acid by thionyl chloride. The acid is prepared by leading phosgene into diethylaniline until no more is absorbed at the ordinary temperature. The crystalline mass which is obtained in this manner is warmed until melted, and the passage of phosgene continued. The product is poured with considerable stirring into dilute acetic acid to remove any excess of the tertiary amine, and is then washed with a little alcohol to remove the colouring matters which are formed at the same time. If necessary, the acid may be recrystallised from alcohol.



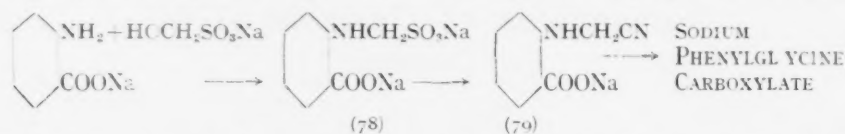
In the preparation of indigo *via* anthranilic acid, phenylglycine-*o*-carboxylic acid is the next important intermediate, and may be obtained by the interaction of chloroacetic acid and anthranilic acid itself with or without the presence of water. This reaction goes best at about 100° C., but if the sodium salts are used in aqueous solution, a temperature of



40° C. must not be exceeded or else considerable quantities of the compound (77) will be formed, by the interaction of the desired product with more chloroacetic acid. In consequence of this, the whole mixture must be stirred together for several days. To avoid this, and to dispense with the use of chloroacetic acid, several processes have been devised, those in which

formaldehyde bisulphite is used being the more commercially successful, since they require no expensive reagents. The

acid with formaldehyde bisulphite to give the product (78), the sulphonic acid group of which is then able to react with



technique of their large-scale working is difficult but has now been put on to a sound working basis.

The first reaction involved is the condensation of anthranilic

sodium cyanide to give the nitrile (79), the latter hydrolysing very easily to the sodium salt of phenylglycine-*o*-carboxylic acid.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

December's volume of trade in dyestuffs varied little from that of the months immediately preceding. Probably the volume is a very close average for the year, and, as such, shows an improvement over previous years. This progress might be satisfactory if it were not for the uneasy feeling concerning the soundness of the cotton trade, on which the consumption of dyestuffs in Lancashire ultimately and chiefly depends.

During the month Imperial Chemical Industries, Ltd., has announced the acquisition of Oliver Wilkins of Derby, the latter being one of the many small but successful pigment manufacturing firms. The step has naturally been the cause of some concern among other pigment manufacturers who, as a whole, are considerable purchasers of dyestuffs, but whatever the reason, it seems too modest a move to carry a serious threat to the position of other makers. There is still no information available concerning the much rumoured acquisition by Imperial Chemical Industries, Ltd., of the British Alizarine Co. Even rumour has been silent during the month concerning possible I.G. and I.C.I. arrangements, and this despite the alleged disclosure of all the details in the American daily press.

It is customary at this period to write enthusiastically of the prospects in the New Year, but it is somewhat difficult to dismiss from one's mind the happenings in the cotton spinning trade during the month. The incomplete schemes of all the various factions, including even the one concerning longer hours and less pay, have once more come to light, and it would seem that the costly and out-of-date but, nevertheless, effective method based upon the survival of the fittest is in force. Under the peculiar circumstances of the financing of cotton spinning mills, there is bound to be a very widespread and serious drain on the resources of the Lancashire population, if, as is to be expected, many mills become bankrupt. There is the further danger also that in the reconstruction—and there will be a reconstruction—the weak features of a system which is old and therefore has outlived its utility, may be perpetuated by some one interest which, at the moment, is powerful enough to safeguard itself at the cost of the industry as a whole.

So far as the dyestuff trade itself is concerned, it may well be that no immediate diminution in consumption will take place, but, on the other hand, it seems impossible to conceive a state of affairs in which the dyestuff-consuming section of the cotton industry can indefinitely retain its relative prosperity.

Yorkshire

During the year just concluded it has been gratifying to be able to report month by month signs of improvement, and actual improvement, of trade. It is regretted that December's trade cannot be reported quite as satisfactory. True, the holidays (and the period was almost general throughout Yorkshire) extended from Friday night to Wednesday morning, which must always make a difference as compared with non-holiday months, but this December was neither better nor worse than that of 1926, when trade was only commencing its convalescence after the coal stoppage. Perhaps a little consolation can be derived from the fact that the turnovers of December of 1926 were much inflated by deliveries of intermediates and colours overdue from previous months. Whether

consolation could be found in another reason would depend largely on one's economy complex; this second reason is that there has been a serious drop in prices during 1927.

Crude benzol is about 6d. per gallon down on last year's price, but there are products which still maintain their coal stoppage high levels, for instance, phenol crystals and cresol; presumably an increased demand has occurred.

It was arranged that the Joint Dyers Executive Committee, which represents the trade unions in the dyeing and finishing departments of the textile industry, should meet in Bradford on Saturday, the 7th inst., in order to consider the position arising from the notice given by the trade unions to terminate all local and sectional wages agreements on the 13th inst. No move on the part of the employers to prevent it expiring is apparent, but, at the same time, fear of any action on either side that would bring the industry to a stop is not in evidence. It is rather felt that a mutual desire exists to work for the common good.

On December 15 new charges came into operation for the dyeing and finishing of wool dress goods, costume cloths, cross dye weft gabardines, and goods containing artificial silk to be wool-dyed only; also a change from a poundage to a yardage basis of calculation, the responsible authorities being commission dyers including the Bradford Dyers' Association, Ltd. Naturally some criticism and opposition ensued, although the revision in the cases of certain quantities of heavier cloths effects a decrease.

Scotland

The year's business finished firmly in December at a level up to that of the two preceding months. The holidays taken were only of normal length, and in one or two cases shorter than usual.

One branch of the Scottish textile industry can certainly look back on a successful year, and good though the position was last January, it is even better now. A particularly satisfactory feature has been the increase in export orders both from America, the Colonies, and Europe. The hosiery sections have certainly been better during the last quarter than for some time previously. Printers, dyers, and bleachers have been moderately well employed throughout the year. Dyestuff sales have remained appreciably constant with increases in the vat and artificial silk colours. The flax industry has remained depressed, while the linen and jute have been much the same as before.

An item of personal interest was the unveiling of the memorial to the late Mr. Alexander Morton, of Darvel, who will be remembered for his services to the Ayrshire lace trade.

Eyes are now turned forward hopefully to the present year. The general feeling is optimistic, but since this is usual at the beginning of January it cannot be taken entirely on its own merits. Last year the outlook was also considered optimistic, but it was remarked in these columns that, although the predominant outlook was one of determined optimism, there appeared to be little substantial basis for anything in the nature of a revival. This view has been confirmed, for the year, although a sound one compared with the previous two or three, was not in any way remarkable. There is a difference, however, between this year's feeling and last, which may perhaps be best expressed by saying that last year the expression of the optimistic views was greater than the actual feeling, but that this year the reverse is the case.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

Market Conditions

THE market conditions in January are generally regarded as good. From Lancashire an increase in sales is reported, but whether the improvement will be maintained is not at present quite clear. Much, of course, depends on the condition of the textile industry, and this is still far from what it should be. One interesting point is the decision of the Bleachers' Association to make a substantial reduction in their charges for cloth, respecting which foreign competition is particularly keen. The operatives are reported to have accepted some reduction of wages, which, at least, indicates a general desire to help a recovery of trade.

From Yorkshire, it is reported that turnovers lately have been appreciably bigger, and that weights must have been still bigger than prices at first sight would indicate. It must be remembered, in judging of the business done, that the tendency of dyestuff prices has been downward for some time past. In the best classes of cloth, trade is reported to be good, with a strong tendency to get back to quieter styles and tones. French and silver greys and blues are in good demand, while browns are popular in second quality cloth. As the result of the sliding scale, the National Union of Textile Workers announces a slight increase in pay to take effect during February.

It is interesting to hear that that monumental and most valuable work, the *Colour Index*, is to be supplemented by further information concerning old and new dyestuffs not contained in the original volume. This is another indication of the intention of the British industry to keep thoroughly abreast of the latest knowledge.

On the whole, the general opinion in Scotland is that, while there has not been much improvement to boast of, January has been a fairly good month. In the chemical markets there was a gradual improvement towards the end of the month in the home trade, with a slight set-back in exports.

Laboratory and Bulk Production

SOME valuable hints were given by Dr. H. H. Hodgson, head of the Departments of Chemistry and Colour Chemistry at the Technical College, Huddersfield, on the important subject of "The relation between Laboratory and Bulk Production" in an address before the Scottish Section of the Society of Dyers and Colourists at Glasgow on Friday (yesterday). The condition of chemical industry before the war was first referred to, and it was pointed out that if the pre-war Patent Act had not been allowed to become a dead letter, there might have been at least three fully equipped factories in this country at the outbreak of war, capable of transformation into the same type of chemical arsenal as their parents on the Rhine. The tendency, even for the devoted chemist, to turn to commercial organisation for a career owing to its superior financial rewards would always make difficult the progress of chemistry, and the only way to counteract the attractions of mammon was to train chemists in such a way that the love for the subject itself would resist external blandishments. The laboratory side of the relationship between laboratory and bulk production would then be efficient in its service, and the chemists would be appreciative of their true function.

From Laboratory to Plant Scale

BEFORE laboratory work could be translated to the plant scale, it was necessary to ascertain how the laboratory process could be carried out with quantities just too large for ordinary laboratory apparatus. That was the stage at which the necessary experience must be gained and the pitfalls consequent on changed conditions be charted before a correct design for the large scale plant could be contemplated. It was essential that the small-scale apparatus should not be capable of manipulation entirely by hand, since a compelled dependence on mechanical aid might lead to the discovery of efficient modes of handling which could be translated to the larger installation. Surprises, which might prove very costly on the large scale, should be welcomed at this stage, as each would prevent a corresponding disaster later. The debated question as to whether the academic training of chemists should include tuition by means of small scale plants was answered in the negative, and Dr. E. F. Armstrong's suggestion of a thorough training in physical chemistry strongly supported. It was during the transition stage of a process, Dr. Hodgson stated, that every endeavour should be made to work out the quantitative relationships of the plant. This did not mean solely the conditions necessary for optimum yields, but the mathematical relationships, expressed by approximation formulæ if possible, of all the quantities involved in the process.

The Missing Link

THIS quantitative study of a plant was claimed to constitute the missing link between the laboratory and plant chemist; as a rule, it was entirely neglected. Sometimes a foreman was found in possession of special knowledge which he most jealously guarded. It has been the lecturer's experience to meet with several instances of this kind, and in every case to find that some very simple scientific principle had been stumbled across empirically. Coming to bulk production, Dr. Hodgson stated that the task of the process chemist was to maintain quality and yield, to effect plant improvements where possible, and to reduce running costs. Not a little also depended on the good-will existing between all the employees, and the process-chemist could be a tower of strength to his firm in this particular. As to the spirit with which the chemist should play his part in industry, Dr. Hodgson commended the study of that excellent pamphlet issued by the Institute of Chemistry, entitled "Chemists and Dividends," by S. M. Gluckstein, (a director of J. Lyons and Co.).

Textile Leaders Honoured

AT the annual meeting of the Bradford Chamber of Commerce on Tuesday, Colonel F. Vernon Willey and Mr. H. Sutcliffe Smith, both members of the Executive of the Chamber, were invested with insignia as Chevaliers of the Legion of Honour. The ceremony was performed by M. du Halgouet, Commercial Secretary to the French Embassy in London, and M. Maurice Dubrulle, representing the French wool textile industry, who were specially authorised by the President of the Republic to make the investiture. M. Dubrulle referred to the work done by Colonel Willey in enabling France to obtain supplies for restarting her textile industries after the war, and to the

work of Mr. Sutcliffe Smith on behalf of trade arbitration. Mr. Smith was, he said, the godfather of the wool textile arbitration agreement between the nations.

German Dye Journal Reappears

The well-known German dyestuffs journal, the *Zeitschrift für Farbenindustrie*, which was forced to suspend publication in the acute economic crisis in Germany after the war, is now reappearing in a new series, of which the first number, that for January, is just to hand. It is to appear monthly, edited by Dr. A. Buntrock. The journal is polylingual, having articles in German, English, and French. Among others, this month's articles deal with the manufacture of β -naphthol, of 1:8-ammonaphthol-4-sulphonic acid, Columbia Black FB, Naphthol Blue Black, tartrazine, cyanide dyestuffs, etc. Mr. L. J. Hooley (who is a regular contributor to our own columns) has an article on "Naturally Occurring Anthraquinone Drugs and Colouring Matters." There are also various articles on plant, economic questions, and other subjects of interest, including five from recent issues of *THE CHEMICAL AGE*. There is an extensive abstract section.

Dyers' Wage Rates

IN accordance with the sliding scale agreement, the change in dyers' wages took effect on the first pay day in February, and the increase will be paid for the whole of the pay week preceding that date. The benefit to the worker will, however, be very slight, the increase varying from 1d. to 3d. per week. Thus, for a boy of 14 in the Yorkshire area, the new rate will be 19s. (old rate 18s. 11d.), 15 years of age, 22s. 6d. (22s. 5d.), 16 years, 25s. 11d. (25s. 10d.), 17s. years, 29s. 5d. (29s. 3d.), 18 years, 36s. 4d. (36s. 2d.), 19 years, 41s. 6d. (41s. 4d.), 20 years, 46s. 9d. (46s. 6d.), 21 years, 52s. 4d. (52s. 1d.).

In the Lancashire area allied trade (cost of living wage only) for males of 21 and over, the new rate for a week of 48 hours will be 22s. 1d. (old rate 21s. 10d.); for males from 18 to 21, 17s. 6d. (17s. 4d.); females 18 and over, 13s. 2d. (13s.); males 16 and under 18, 12s. 5d. (12s. 3d.); females 16 and under 18, 10s. 3d. (10s. 1d.); males under 16, 9s. 6d. (9s. 5d.); females under 16, 8s. (7s. 11d.). There is still a little uncertainty as to the outlook, but every effort is being made to avert a conflict. Approximately 85,000 operatives are involved in the dyeing and finishing industry, and between 200,000 and 250,000 employees are concerned with any action that may eventually be taken by employers connected with the Industrial Council.

January Dyestuffs Licences

THE following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during January has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—The total number of applications received during the month was 573, of which 461 were from merchants or importers. To these should be added 17 cases outstanding on December 31, making a total for the month of 590. These were dealt with as follows:—Granted, 531 (of which 508 were dealt with within 7 days of receipt); referred to British makers of similar products, 38 (of which 30 were dealt with within 7 days of receipt); outstanding on January 31, 21. Of the total of 590 applications received, 538, or 92 per cent., were dealt with within 7 days of receipt.

Amalgamation Rumours

RUMOURS continue in circulation respecting possible further amalgamations in the dyestuffs industry. "It is conceivable," remarks the *Financial News* in reference to one of these rumours, "that the investing public as a

body know little of the British Alizarine Co. This is an undertaking formed as far back as 1882, with headquarters in Manchester, for the manufacture of certain colouring matter, known to the trade as alizarine, from coal-tar products. The company also owns dye patents of considerable value formerly worked by British Synthetics, Ltd. Although lacking confirmation at the moment there is good reason for belief that Imperial Chemical Industries, Ltd., is prepared still further to pursue its policy of expansion by acquiring the assets of the British Alizarine Co. The last-named has an authorised capital of £600,000 and an issue of £532,000, in £1 shares, of which, however, a large number are only 15s. paid, so that the paid-up capital represents £457,000. As at December 31, 1926, its balance-sheet total was £786,200; fixed assets, goodwill, etc., appearing at £581,326. The profit for 1926 was £11,900; the sum of £20,000 was written off, and the undivided balance forward was £49,390. The last distribution was that of 2½ per cent. in respect of 1924. Earnings have varied considerably of late years.

An Australian "Discovery"

WE have frequently heard references to the wizardry of modern dyestuff chemistry, but have come across nothing quite so superlative as the claims made in respect of a "dye discovery" reported from Melbourne. The author, Mr. C. F. Lloyd, is not a chemist, but for seven years has been experimenting with dyeing processes; in fact, he confesses that "he has been mad on mixing things since he was a child of twelve years." Some of the reports may have undergone a little of the latter process. The secret, it is stated, lies in the ability to "dye down" instead of to "dye up"—which we take to mean that darker shades may be converted to lighter shades.

At a demonstration before Melbourne business men, Mr. Lloyd is reported to have poured a faint amber liquid into a wooden vat containing water, and then put into the vat brown stuffs, black cashmere stockings, navy blue silk, delicate maroon lace stuffs, striped blue and white woollen cording. Steam under pressure raised the temperature of the dyeing mixture. Ten minutes later the brown stuffs had become pale pink, the black stockings were mauve, the navy blue silks had changed to the subtlest of emerald greens, the maroon laces looked the purest cream, and the striped cord was vieux rose and white. All had been in the same vat for the same time. The liquid in the vat was still as clear and transparent as before. The most convincing experiment, it is stated, was the transforming of the dainty silk lace from black to pink. Another "marvel," we learn, is the discoverer's ability to take multi-coloured stuff and eliminate or change any particular colours in one process. Mr. Lloyd also has a dry process usable with fragile material which is undyeable when wet without being ruined. The Government analyst, we are glad to learn, has certified the fastness of the colours, and presently may give us an authentic report on the demonstration and the process. Meanwhile, the Melbourne *Herald* has convinced itself "that the demonstration would have made every dyer in Europe and America open wide his eyes." It is quite possible!

Artificial Silk Dyes

THE use of artificial silks, as a writer in *The Times* points out, is largely on the increase both as such and in unions. They present dyeing problems of their own, one of the best known of which is the "barring" effect which causes difficulties in level dyeing. The Icy colours, which were placed upon the market in 1926, have such affinity as to eliminate the effect; they represent the first step on the road that, it is hoped, will lead to a series of colours which not only will surmount the effect, but will possess the other properties which are necessary.

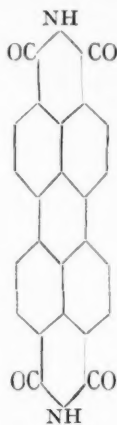
Dyes and Their Application: Technical Progress in 1927

By L. J. Hooley

The author, who regularly keeps readers of this journal informed of progress in dyestuff chemistry, completes in this issue a comprehensive review of the advances made in 1927. The first instalment appeared in the January issue of this supplement.

Perylene Dyes

Research in perylene derivatives seems, at any rate for the time being, to have passed its zenith. Different methods of halogenating and nitrating perylene have appeared and more attention has been given to sulphonation. Apart from these, the production of dibenzanthrone and similar substances by the condensation of perylene with aryl residues has been tried in several ways. A good deal of the work in this field is being done by individual investigators, Pereira, Zinke, Pongratz, Bensa and Marschalk, and is reported in the chemical journals.



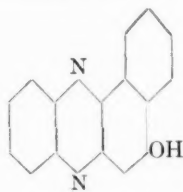
Dinaphthalimide, which is generally included in this class, dyes claret shades, but is lacking in tinctorial value. The British Dyestuffs Corporation have found that it can be improved by treating with warm sulphuric acid (E.P. 280,647, Hailwood, A. J.).

Wool Vat Dyes

There are already quite a considerable number of these available, and during the year attempts have been made to establish these on the market rather than to bring out new products. Some of the important dyes are already using these, and their value is being increasingly recognised.

While in the past many of these have belonged to a class of their own, it has been shown that some of the anthraquinone vats, especially the cold dyeing ones, are admirable for the purpose, and if the dyer is taking up vats on account of their fastness it becomes worth while to select the most permanent.

The wool vats are sold both in the ordinary form and as special vatted preparations. For these latter alkali starch or alkali and starch are preferable to alkali, according to E.P. 259,900 (I.G.F.A.-G.). New quinone vat dyes are obtained by condensing hydroxy phenazines, e.g., 5-hydroxy- α : β -naphthaphenazine (formula shown) with hydroxy-*p*-quinones.



Azo Colours

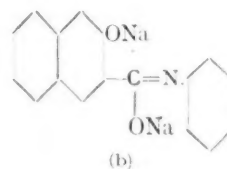
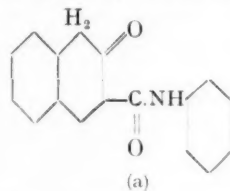
The usual large additions to the numbers of the azo compounds have been made during the year, these including direct, chrome and ice colours. There are already several very fast yellows in the azo-pyrazolone group, but new ones for wool, stated to be superior to the known ones, are obtained by coupling aromatic diazo compounds with a methyl pyrazolone or a pyrazolone carboxylic acid derived from an aminodiaryl sulphone (E.P. 245,765, I.G.F.A.-G.). Yellows, oranges and browns fast to chrome are also prepared, from hydrazino-4-hydroxy-3-carboxy diphenyl sulphides which are converted to pyrazolones and then coupled. In these the chromophore is screened by the sulphide bridge as previously described in E.P. 260,058 (E.P. 272,024, B.D.C. and Mendoza, M.).

Azo dyes similar in constitution to those obtained from the hydroxy naphthoic acid arylides, but modified by the presence of sulphonic acid groups in the oxy-naphthoic acid nucleus, are obtained in E.P. 263,164 (I.G.F.A.-G.). Very fast products result from the *o*-toluidide of oxynaphthoic acid if both components contain chlorine (A.P. 1,622,690). Diazotised *p*-phenylene diamine coupled with β -naphthol, again diazotised and then coupled with the 2:3-hydroxy naphthoic 5-chlor 2-toluidide gives a fast black (A.P. 1,635,594, Gresselli).

The deterioration of 2:3-oxynaphthoic acid arylides which takes place on standing after the goods have been impregnated in a solution of the arylide in caustic soda and Turkey red oil is due to the formation of the isomeric non-coupling form (a) (see below). The question is considered at length by Higgins (J.S.D.C., 1927, 213-219).

Modified methods of preparing the arylides as well as a

number of different arylides and amines which may be used are proposed by various authors.



Azo colours containing copper, zinc, magnesium and chromium are dealt with in E.P. 247,694, 249,884, 260,830, 269,522, 272,908, 272,949; A.P. 1,617,872, 1,263,005; and E.P. 609,518.

Charrier and Beretta have isolated the metallic compound obtained by treating phenyl azo β -naphthylamine with copper sulphate in ammonia (Gaz. Ch. It., 1926, 856), $\text{Cu}(\text{C}_{10}\text{H}_6\text{N})_2$.

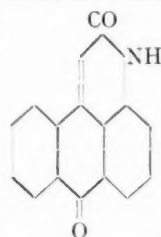
Azo colours may be combined with sulphur colours by dyeing with one azo component and the vatted sulphur dye and then developing with a diazo solution and oxidising at the same time (E.P. 266,837, I.G.F.A.-G.).

Dry or stable diazo preparations are obtained by mixing with partially dehydrated alum or with free aryl sulphonic acids. Prints and dyeings fast to washings are obtained by methods using sulphonitrosaminic acids.

Acetyl Silk Dyes

Among new amino anthraquinones for this purpose, there are anthraquinone-1:4-diamino-2-alkoxy and substitution products of 1-amino-2-sulpho-anthraquinone (I.G.F.A.-G., E.P. 272,482; G.P. 433,376).

Sulphamic acids, especially of amino anthraquinone derivatives, have excellent solubility, and give fast shades. The sulphamic acid from 1:4-diamino anthraquinone gives reddish violet shades, similar to the diamine itself (I.G.F.A.-G., E.P. 267,695). The sulphamic acids are dyed from an acid bath with Glauber's salt (E.P. 610,539). The shades may be improved by after treatment with a diazo compound (U.S.P. 1,602,295). The British Alizarine Co. obtain a range of brilliant shades from the anthrapyridones, these being produced from the acetyl amino bodies in the usual way; the simplest one (shown herewith) is yellow.



The British Alizarine Co. also obtain yellow to orange shades by using nitro acridines (Dawson, W. H., Soutar, C.W., and Wood, R. J., E.P. 275,572). J. W. Leitch and Co., and A. E. Everest (E.P. 261,882) use dinitro amines, in which both nitro-groups are ortho to the amino group. No additions to the dyebath are necessary, and as the colours can be dyed from acid, alkaline, or neutral bath, they are especially suitable for mixed fibres, and for use with other dyestuffs. A large number of azo dyes have been prepared for acetyl silk, and are described in the following:—E.P. 269,934, 270,351 - 2, 274,823, 275,230, 275,307, 275,373. In E.P. 270,428, brown shades are obtained by means of disazo dyes of the type nitroarylamine-amine-aminobenzene (B.D.C., Baddiley, J., and Hill, J.). In E.P. 275,373, sulphonylides are employed (B.D.C., Horsfall, R. S., Lawrie, L. G., and Hill, J.).

There are also a considerable number of other patents dealing with various aspects of application, and including several taken out by British Celanese Co.

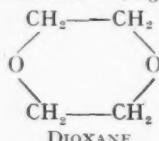
Dyeing and Printing

Dyeing chemistry appears to be rapidly becoming "surface chemistry." The published work on wetting out, solubilising, and dispersing chemicals threatens to become large enough to form a literature of its own. From some of the results claimed it might appear that it was only necessary to get particles of the right size properly into contact with the

substance in order to make any substance fulfil the function of a dyestuff. At present it is too early to see how far the new results will go, but substantial improvements in dyeing have been made.

New dispersing agents are still appearing, but a large part of the new work consists in finding wider application for the existing ones, e.g., in the preparation of pigments and varnishes, in mordanting and for printing pastes, for bleaching and finishing operations and for the destruction of animal and vegetable pests.

The substances themselves may be classified roughly into those of an oily or soapy nature, those having pyridine and other organic bases as a foundation, hydrolytic and decomposition products of various animal and vegetable substances, and synthetic products, a great majority of these latter being sulphonic acids. In addition to the large number of alkyl naphthalene sulphonic acids and allied bodies, sulphonated formaldehyde condensation products etc., the following have been recently described: Sulphonated mineral oils from brown coal tar, petroleum oil, and shale tar oil (E.P. 269,942, I.G.F.A.-G.), sulphonated hydroaromatic hydrocarbons (E.P. 271,474, I.G.F.A.-G.), palmitobenzene and stearotoluene sulphonic acids (E.P. 246,507, Chem. Fab. Milch A.-G.), sulphonated residues from turpentine (E.P. 271,898, S.C.I.B.), and sulphonated products from mineral oil fractions and alcohols (B.P. 274,611, B.D.C., Baddiley, J., and Chapman, E.) Remarkable dissolving properties are claimed for dioxane, e.g.,



Phosphoric esters have been recommended in E.P. 267,534 (I.G.F.A.-G.), for the preparation of dye pastes. For the level dyeing of viscose silks the British Dyestuffs Corporation have brought out their new series of Icy colours. For obtaining level results in cotton-viscose silk mixtures, Alterhoff scours the grey goods in a bath of soda ash and Monopole soap, and then dyes with Glauber's salt and soluble oil. New secondary disazo dyes obtained by coupling an amino salicylic acid with a middle component and a sulphonated naphthol or naphthylamine give level shades of blue, brown, violet, and black on viscose (E.P. 276,757, B.D.C., Baddiley, J., Chorley, P., and Butler, C.)

For wool-silk unions certain pyrazolone azo dyes with carboxylic ester groups along with free carboxylic acid or sulphonic acid groups to give first sufficient solubility can be used (E.P. 247,224, I.G.F.A.-G.).

Aldehydes and ketones are commonly employed for the protection of wool in alkaline operations, but these are now used also in acid dye-baths (Cassella, G.P. 433,135). A solution of wool waste in alkali may be used with the same object according to Haberkorn (E.P. 275,374). Fuller's earth may be added to the dye-bath to improve the fastness to rubbing of acid dyes and soluble vat dyes (D. and H., E.P. 255,501).

For skins, furs, etc., a black of the type of aniline black may be got with 2,4-diamino diphenylamine. The British Dyestuffs Corporation and R. S. Horsfall (E.P. 268,952) use the N-alkyl- ω -sulphonic acids of amino anthraquinones, for fur dyeing. Contrary to the case in acetyl silk dyeing, they are here dyed under such conditions that the soluble groups are not hydrolysed.

Apart from some modified methods of printing and discharging vat colours, preparing printing pastes, etc., there is little new in printing.

J. W. Leitch and Co. and A. E. Everest precipitate pigment colours with insoluble soaps and then grind, for example, in a colloid mill; these can then be obtained dry, but very finely divided (E.P. 272,585).

Intermediates

In nitration processes, Battagay (E.P. 262,097) uses nitrogen tetroxide in sulphuric acid, Livingston and Kyrides (U.S.P. 1,638,045) obtain nitrobenzene in theoretical yield by adding sodium nitrate, 95 per cent. sulphuric acid and benzene to a mixture of 81 per cent. sulphuric acid, benzene and nitrobenzene at a temperature of 80-110° C. J. W. Leitch and

Co. and A. E. Everest prepare dinitro derivatives of *o*- and *p*-toluidine, *p*-chlor aniline and aniline after first protecting the amino group with *p*-toluene sulphonylchloride. In E.P. 263,018, a method is given for separating mixtures of nitro toluenes (B.D.C., Rodd, E. H., and Everett, R. W.). By slight modifications in the ordinary iron reduction of amines, the iron oxide remaining is obtained in a form suitable for pigments (E.P. 263,376 274,562, I.G.F.A.-G.) The catalytic reduction of nitro compounds can be carried out in the vapour form by passing with hydrogen over heated silica gel impregnated with a little heavy metal or metal compound. Temperatures in the neighbourhood of 200° C. are used and good yields are claimed (E.P. 260,186, I.G.F.A.-G.) Poisoning of the catalyst in reduction of nitro compounds is avoided by impregnating with an alkaline earth or rare earth metal or compound (G.P. 436,820, I.G.F.A.-G.) Amines can be obtained by the replacement of active halogen atoms without the use of pressure by heating with carbamide (E.P. 263,552, Bentley, Blyth and Co.) Methylation of amines can be carried out catalytically with dimethyl ether. Aniline passed over alumina at 270-310° C. with five or six times the theoretical quantity of ether gives pure dimethylaniline (E.P. 275,377, Mackert).

Primary and secondary arylamines are separated from tertiary ones by converting the first two to sulphamic acids with chlorosulphonic acid, distilling off the third from alkaline solution with steam, and then hydrolysing the sulphamic acids remaining. Secondary amines are also separated from tertiary with phosgene, the carboxyl chloride of the secondary base being formed (E.P. 270,930 and 273,923, B.D.C., Rodd, E. H., and Everett, R. W.). Higher yields of phenols are obtained in the diazotisation of amines by removing the phenol as formed by agitating with a solvent (E. P. 274,960, Crawford and Wilson). Amines of hydrogenated hydrocarbons are obtained from cyclohexylhalides and amines, which may also be afterwards alkylated, or by the hydrogenation of arylamines (E. P. 261,764, 261,747, 276,571, G. P. Appln. S. 65,950).

Several new methods and furnaces for the manufacture of aluminium chloride have been described in American and Canadian patents. In vapour phase oxidations of hydrocarbons, the use of the catalyst in finely divided condition as smoke is given in E.P. 263,201 (Caspari).

Ring formation can be brought about in the vapour condition by passing over silica gel, ketones such as phenyl-*m*-xylol ketone, which gives β -methylantracene (E.P. 251,270, I.G.F.A.-G.) Fluorsulphonic acid is stated to show advantages over chlorosulphonic acid in cyclisation processes, giving higher yields with less tendency for sulphonation. In B.P. 276,156 (B.D.C., and Wyler, M.), methods of separating the quinaldine bases obtained in the Döbner-von Millar reactions are given.

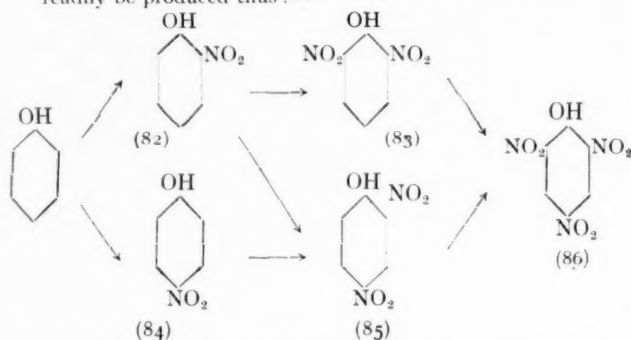
The Silk and Rayon Guide

THE 1928 edition of *The Silk and Rayon (Artificial Silk) Directory and Buyers' Guide of Great Britain* has just been issued by John Heywood, Ltd., of Deansgate, Manchester (pp. 321, 21s.) The publishers are to be congratulated on the remarkable amount of valuable information which is contained in this volume. The section headings are as follows: Artificial silk Customs duties; identification of artificial silk; consultants, professors, etc. on silk and artificial silk; terminology of the artificial silk industry; chronology of artificial silk (giving in condensed form a history of the rise and progress of the industry) associations, trade organisations, etc.; artificial silk producers (this section is not restricted to Great Britain, but covers the whole world); world's output of silk; progress of the artificial silk industry in 1927; trade names of silk and rayon manufacturers, and of silk and rayon fabrics and goods; classification under the names of towns of manufacturers, spinners, dyers, agents, engineers, etc., for silk and artificial silk (95 pages), this completing part 1. Part 2 of the book is a classified buyers' guide (131 pages). This is divided into sections dealing with processes; raw materials, yarns, etc.; fabrics, woven and knitted; goods, woven and knitted; machines and appliances; chemicals, dyestuffs, wood pulp, stamping pastes, etc.; and packing materials, etc. This publication is a model of its kind, and nobody connected with the industries concerned can afford to be without it.

Basic Intermediates for Dyestuffs: No. XV.—The Nitro-Derivatives of Phenol

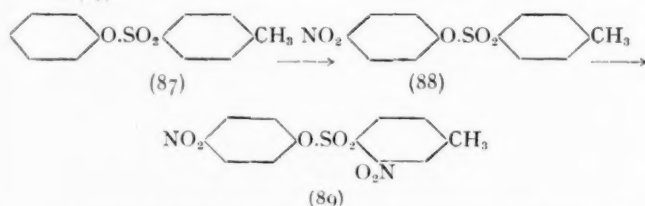
By "Consultant"

ALTHOUGH the nitrophenols, as such, find only the most limited use in the manufacture of dyestuffs, they are used to a considerable extent in the manufacture of intermediates of the first importance. Thus, *o*-nitrophenol gives rise to *o*-anisidine and dianisidine, *p*-nitrophenol to *p*-phenetidine, dinitrophenol to nitroaminophenol, and picric acid to picramic acid. The nitration of phenol or of its 4-sulphonic acid gives rise to compounds which are invariably substituted in the ortho and para positions, and by adjusting the conditions of nitration the mono-, di- or tri- nitro compounds can very readily be produced thus:—



Where direct nitration is practised the amount of *ortho*-nitrophenol obtained is about 40 per cent., and *para*-nitrophenol 50 per cent., with a mere trace of the *meta* derivative. Further nitration leads almost exclusively to the 2:4-dinitrophenol, although by nitration of *ortho*-nitrophenol with cold fuming nitric acid it is possible to obtain a small amount of the 2:6-dinitrophenol (83) which is isolated through the solubility in water of the barium salt. Almost the whole product of further nitration is the symmetrical compound (86), picric acid, since the nitro group shows an excessively marked reluctance to enter the position *meta* to the hydroxyl group; *meta*-nitrophenol can only be obtained by indirect methods from *meta*-nitraniline, and compounds such as 2:3 and 3:5-dinitrophenol are very difficult to produce.

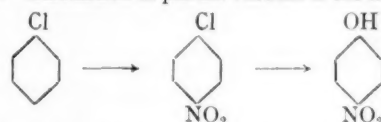
Technically, the process used for the preparation of the mononitrophenols depends upon whether the *para* derivative alone, or the mixture of *ortho* and *para* derivatives, is required. In the former case the phenolic group is condensed with a sulphonic acid chloride so that a more strongly *para* directing group is obtained. The acid chloride which is used commercially for this purpose is toluene-*p*-sulphonic chloride, which is obtained either by the action of thionyl chloride on toluene sulphonic acid, or preferably by the action of chlor-sulphonic acid on toluene itself. Large quantities of this compound are obtained as a by-product in the manufacture of saccharin. The compound produced with phenol is shown in (87).



Phenol (1 cwt.) is converted to its sodium derivative by stirring with caustic soda (25 lb.) and water (100 galls.). The solution of sodium phenate is heated to 60° C. with live steam and toluene-*p*-sulphonchloride (1 cwt.) is slowly run in with continuous stirring. The stirring is continued until all smell of the sulphonchloride has disappeared, after which the mass of condensation product is filtered off at the press and the cake washed with a little water. It is essential that the product be completely dried at this stage, if a maximum

yield of *para*-nitrophenol is to be obtained. When dry it is ground with an equal weight of sodium nitrate and the mixture (2 cwt.) is slowly added to 95 per cent. sulphuric acid ($\frac{1}{2}$ ton). The temperature is not allowed to rise above 15° C. in order to restrict the action to mononitration of the phenol residue, but even so the excess of nitric acid also effects the nitration of the tolyl residue at the position *ortho* to the sulphonic group giving the compound (89). This is all to the good since although the mononitro compound can be hydrolysed, the temperature necessary leads to the destruction of part of the product; on the other hand, the hydrolysis of the compound (89) is more easily effected. The nitro compound forms a paste with the sulphuric acid from which it is separated by centrifuging. It is washed with a little water and suspended in ten times its weight of caustic soda solution (S.G. 1.33) and the mixture gently heated with stirring at 100° C. until all has gone into solution. The nitrophenol can then be extracted by acidification.

The decomposition of chloronitrobenzene with alkali also gives a convenient method for the large scale production of *para*-nitrophenol. 4-Chloronitrobenzene may be produced by the nitration of monochlorobenzene, and is stirred with warm strong caustic solution until solution is complete, after which acidification readily gives the nitrophenol. The details of the process are so straightforward that no further description is necessary. Distillation in partial vacuum is the most suitable



method of purification.

The direct mononitration of phenol is accomplished by the following method: Nitric acid (S.G. 1.38; 2 cwt.) is mixed with 50 per cent. more than its own weight of water, and phenol (1 cwt.) which has been liquefied by the addition of a small amount of water is slowly run in with much stirring. The temperature is not allowed to rise above 35° C. and ice is added (equal in weight to half that of the nitric acid originally used) from time to time in order to keep the temperature under control. When all the phenol has been added the temperature is allowed to reach the normal, and after settling two hours, the top layer of acid is separated by syphoning and the residual oil washed with water and distilled in steam. The *ortho* derivative passes over with the steam; the *para* compound may be obtained by extracting the residue with several charges of boiling water and allowing the united extracts to cool. The *para*-nitrophenol separates out mixed with tar and needs a further purification before it can be used. It is dissolved in ten times its weight of water, together with one-third its weight of chalk, by blowing in live steam. The boiling solution is filtered and treated while still hot with sufficient soda ash to precipitate all the calcium as carbonate, and with salt equal in weight to the original charge of crude material. The mixture, reheated to boiling, is filtered from the calcium carbonate and allowed to cool, when pure *para*-nitrophenol separates.

2:4-Dinitrophenol

2:4-Dinitrophenol may be prepared by the direct nitration of phenol, but it is more conveniently produced by the action of alkali on 4-chloro-1:3-dinitrobenzene. The latter compound (1 cwt.) is stirred with a solution of soda ash (1½ cwt.) in water (200 galls.) and the whole heated under reflux in a large lead-lined digester fitted with a lead condenser tube. The removal of the chlorine group takes about 24 hours continuous refluxing, after which the liquor is acidified in a large vat with hydrochloric acid. The dinitrophenol separates and is removed by filtration.

The process of direct dinitration, as applied to phenol, is conducted thus: The phenol (2 cwt.) is added to slightly warmed sulphuric acid (95 per cent.; 4 cwt.). The temperature is raised gradually, and with stirring, to 110° C., and

at the end of five hours' heating to 135° C. It is then cooled somewhat and water (60 galls.) added. When the whole has cooled to normal temperature, dilute nitric acid (145 galls.; 31 per cent. HNO_3) is run in at such a rate that the temperature does not exceed 35–40° C. The reaction mixture is well stirred and allowed to stand for 24 hours, after which it is slowly heated by a water jacket to a temperature of 80° C. for three days. The cooled liquid is filtered from the cake of almost pure dinitrophenol which separates. It forms yellow crystals m.p. 114° C. and is used in the preparation of nitroaminophenol and of dyes such as Chrome Fast Green.

Picric Acid

Picric acid (*sym*-trinitrophenol) is invariably made by the continued nitration of phenol, and of all the nitrophenols it is the simplest to produce. It is claimed by many process men that, for the production of picric acid, the coal-tar phenol is more suitable than the synthetic. The difference is usually attributed to the presence in the coal-tar phenol of a small quantity of some unidentified impurity which acts as a catalyst during nitration. This point has not, however, been satisfactorily elucidated. The acid used should contain 94–95 per cent. of H_2SO_4 , since the use of an oleum, even with a very low content of SO_3 , invariably yields a low grade picric acid, owing to the formation of sulphones during the sulphonation. Additional precautions have, of course, to be taken in the manufacture of a substance such as picric acid on account of its explosive properties. For this reason all the liquids used are to be filtered from grit which may choke up the syphons by which the nitric acid is introduced or may even introduce dangerous abrasive particles into the final acid.

The phenol is liquefied by the gentle heat of a steam coil, and sulphuric acid (4 cwt. for each cwt. of phenol) is run in with gentle agitation. This operation is conducted in a large earthenware vessel, in which the reaction may be completed by allowing the reactants to stand for 24 hours. Judicious heating to 70° C. for an hour or two will, however, enable the sulphonation to be completed in about 8–10 hours. The phenol sulphononic acid sets to a white jelly and must be diluted before nitration in order to avoid loss by violent nitration and oxidation of a part of the phenol to oxalic acid. The sulphononic acid paste is shovelled out with acid-proof shovels into an equal weight of water and pumped to settling tanks in which any suspended matter is deposited.

The sulphonate solution from about 40 lb. of phenol is run into an earthenware pot of about 50–60 gallons capacity. No temperature-regulating or stirring devices need be provided and the nitric acid (160 lb., s.g. 1.4) is run in through a glass syphon at such a rate that the addition takes four or five hours. The acid is allowed to flow into the surface of the sulphonation liquor, and the nitration, which usually commences at once, may be left to complete itself. In some cases, usually about one in fifty, the reaction starts suddenly and violently with oxidation of the phenol as well as nitration. The yield of picric acid is thereby diminished. The picric acid separates out in small crystals ("grain") and in larger aggregates ("lumps.") The latter are more or less impure, containing inclusions of dinitrophenol, and are usually crushed and returned to the pots. After standing for two days the crystals are removed and washed in vats with agitating paddles; the crystals may then be centrifuged and dried by gentle warmth.

The Spectrophotometer in the Dyestuffs Industry

An Instrument of Growing Importance

The growing use of precision methods in the dyestuff and related industries is exemplified by the attention which is being paid to the use of the spectrophotometer. This subject has been discussed by C. Z. Draves (of the du Pont de Nemours Co.) before the American Association of Textile Chemists and Colourists, in a paper the more important points of which are given below.

THE spectrophotometer, an instrument which can be used for measuring the relative concentration of coloured substances in solution, is a scientific tool that has been available to the industrial world for a number of years. A considerable literature has grown up dealing with the use of the spectrophotometer in the solution of theoretical problems, in the fields of chemistry and physics, and many writers have shown that it can be employed in the estimation of dyestuffs. But so far as I know, there has never been a publication from within the dyestuffs industry itself which has presented any considerable data dealing with a wide range of colours to indicate whether or not spectrophotometric methods can be of commercial value to the dye manufacturer or purchaser. In this paper there will be presented to your Association the results of the experience of the Du Pont Co. with the spectrophotometer as an aid in the accurate standardisation of dyestuffs. A few points with regard to the technique employed in spectrophotometric methods also will be considered in a very general way.

Work of the Bureau of Standards

The laboratory of the U.S. Bureau of Standards was the first in America to do any large amount of work with the spectrophotometer in the estimation of dyestuffs. Scientific Paper No. 44e of June, 1922, from that laboratory describes the apparatus and procedure employed in a study of the spectral transmissive properties of the seven permitted food dyes. Later, Appel and his assistants in the colour laboratory of the same bureau examined twenty-three competitive samples of an Acid Blue Black with the spectrophotometer and compared with the results with titration values and with values obtained by a special dyeing method. (*J. Ind. Eng. Chem.*, 627, 1926).

These authors urged dye manufacturers to adopt type standards for the more important colours, the characteristics of which could be defined with spectral absorption curves.

Since the principles of a spectrophotometric examination of a dye solution may not be wholly clear to everyone, it perhaps will prove advantageous before going farther, to explain the

underlying idea very briefly by using a common example. A dilute acetic acid solution of Methyl Violet appears violet to the eye because white light which traverses such a solution has abstracted from it a large proportion of its green, yellow and orange. If a beam of white light, after passing through a cell containing a dilute Methyl Violet solution, is examined in a spectroscopic which spreads out the beam into a wide rainbow of constituent elements of gradually differing wave lengths, it will be observed that the two ends of the spectrum are nearly as bright as without the interposed solution. In the middle of the spectrum, however, it will be seen that there is considerable absorption of light and that the greatest absorption takes place in the yellow at a wave length of approximately 584 millimicrons. The mixture of violet, blue and red light transmitted by the Methyl Violet solution appears violet to the naked eye. The spectrophotometer is a device by which the proportion of light absorbed in the different parts of the spectrum by such a solution can be quantitatively measured.

Technique and Instruments

For the determination of the relative strengths of two dye samples by means of the spectrophotometer it is necessary to compare the relative light absorptive powers of their solutions only at that portion of the spectrum where the absorption of light is at its maximum. In the case of Methyl Violet, as we have said, the maximum absorption occurs in the yellow at about 584 millimicrons. Since Beer's Law is valid for properly prepared solutions and within the differences in strength encountered in commercial samples, namely the relative concentration of a coloured substance is proportional to the absorption in logarithmic units, a comparison of the readings for the two Methyl Violet solutions at this wave length gives a comparison of their relative strengths. Of course, this simple relation is true only when the comparison is made with the same size of sample and the same absorption cell.

It will be understood from this hasty exposition of the method that the spectrophotometer is not at all a colorimeter. Perhaps the hardest thing to make clear to the person who has

had no experience in this field is that the latter instrument operates on entirely different principles. In a colorimeter solutions of both standard and sample are matched against each other simultaneously by varying the thicknesses through which light traverses the solutions until the depth of colour for both is apparently the same. The operator sees the colours of the solutions in the instrument just as they appear to the naked eye. In fact, any slight differences in hue become very pronounced.

In the spectrophotometer, on the other hand, only one coloured solution is inserted at a time. There are two beams of light in the instrument, however, one of which passes through a cell containing the dye solution and the other of which passes through an identical cell containing only the colourless solvent. Both beams are then dispersed into a spectrum by the same prism, and the same portions of the spectrum for both beams appear in the respective halves of the optical field. The intensity of the proper portion of the spectrum of the beam which has traversed the solvent alone is decreased by means of rotating sectors, Nicol prisms, or other device until it just equals the intensity of the light of the same spectral hue which has succeeded in passing through the solution of the dye and which appears in the other half of the optical field.

After an absorption value has been obtained for the standard in this manner the same process must be repeated for the unknown sample. The ratio of the two light absorption values is equal to the ratio of the concentrations of the two dye solutions. It is evident that in such a method any personal idiosyncrasies in colour matching are eliminated, since light intensities of only the same spectral hue are compared. It is said that even colour-blind persons are capable of such photometric comparisons. That a colorimeter is indeed much less accurate than a spectrophotometer has been emphasised by Schertz in his report on a coloured substance called xanthophyl.

Working Out Procedure for Routine Tests

For the routine determination of the strengths of dyes by means of a spectrophotometer a procedure must be developed which is both simple and reliable. This means that the proper concentration to get a suitable reading on the instrument, the proper method of dissolving the dye, the proper solvent for dilution to give a stable and insensitive solution and finally the wave length of maximum absorption, must be worked out for each individual dyestuff. The kind of solution in which the dye is examined and its acidity or alkalinity must receive careful consideration. Another condition affecting the absorption that has not been accorded the proper attention in the literature is the temperature of the coloured solution. The safe procedure is to make up all final dye solutions of both standards and samples at exactly room temperature.

The filling of the glass absorption cell with dye solution is a part of the spectrophotometric method that must be accomplished with great care in order to obtain concordant results. The end glasses of the cell must be clean and dry and the solution must remain absolutely clear. It is difficult to obtain a perfectly clear solution in cells with screw caps on the end and also in cells put together with litharge and glycerine cement.

The type of instrument employed in spectrophotometric work is of the very greatest importance in attaining the speed and accuracy which should be demanded. A spectrophotometer for practical routine service in the determination of light absorption values must be easy of adjustment and when once adjusted must remain in that condition for long periods. At the present time only visual instruments seem to be sufficiently simple for reliable operation by the ordinary industrial technician. There is little doubt, however, but what the instrument of the future will be one employing a photoelectric cell with the entire elimination of the human eye in making photometric matches.

The Value of Spectrophotometric Methods

Our discussion thus far has not concerned itself with the value of spectrophotometric methods to the dyestuffs industry. This phase of the question, however, must receive first consideration before managers can decide whether or not it is worth while to become interested in such methods.

The spectrophotometer will undoubtedly take its rightful place in the manufacture and testing of dyes when all concerned appreciate not only its uses but also its limitations. The uses in increasing order of importance are evident in the following kinds of work: (1) identification, (2) research, and (3) routine standardisation and testing of dyestuffs.

Identification of Dyestuffs

The usual identification of dyes is based largely on the colour changes which they undergo when treated with weak and strong acids and bases, or, in other words, upon their behaviour as acid base indicators. The spectrophotometer simply serves as a refinement of technique in following these changes. But just as refinements of technique are often not necessary in other fields, so also here it is usually possible to make a satisfactory identification with the very quick and older spotting tests. However, it is true that the change in the ratio of the absorption values for light at two wave lengths from one PH condition to another is a very positive and beautiful proof of the identity of a dye even when such a change may not be very evident to the naked eye.

The wave length of maximum light absorption of a dye solution is also a characteristic property which serves as a quick means of identification. But for the determination of this wave length a spectrophotometer is not nearly so satisfactory as a spectrometer of the type manufactured by Zeiss expressly for the purpose. The low dispersion and yet high resolving power of the latter instrument permits of the very accurate location of the wave length of the apparent centre of the dark absorption band, the whole of which can be seen in the field of view of the instrument. The width of this dark band is best regulated by changing the length of dye solution in a Baly absorption cell.

Mr. Wilmot, of the A. C. Klipstein Co., has catalogued several hundred dyes in this way and has found this method very satisfactory for purposes of identification. It may be remarked that a buffer solution really should be used in making up the dye for this determination. The reason one can work fairly satisfactorily without it is that although the value of the maximum absorption usually changes perceptibly with a slight change in the PH of the solution near the neutral point, the location of the maximum changes but little, if at all. Extreme changes in acidity or alkalinity, on the other hand, often cause the complete disappearance of one absorption band and the appearance of another. The shift of the wave length of the maximum with dilution and with the addition of alcohol, is another characteristic property that may be used for identification.

Uses of the Instrument for Research

In both theoretical and industrial chemical research there will be found an increasing usefulness for the spectrophotometer. Purely scientific problems concerning the chemical structure of compounds can often be solved by means of this instrument. The behaviour of indicators, equilibria between tautomeric forms and reaction velocities are other fundamental problems which have been found amenable to spectrophotometric methods.

To the research chemist in dye manufacturing, a spectrophotometric laboratory can be of distinct service. It can give him the dye content of a whole series of samples for the study of improvements in process more quickly, more accurately and more cheaply than he could obtain such results by dye test. At the same time the relative purity of the different samples of crude dye can be reported from a consideration of the variations in the absorption curves. Even though the values for dye content from the instrument might not correspond exactly to the actual dyeing strengths of the samples, nevertheless, they are very satisfactory to use in the calculation of yield figures, for the reason that they are not subject to the personal factor always attendant upon the judging of skeins which are not all of the same shade.

Although the most important use of the spectrophotometer for the dye industry at the present time is in the routine standardisation of dyestuffs, this usefulness is in the determinations of strength rather than hue, or shade. Our experience has been that the absorption curves of solutions cannot be employed alone with reliability for the standardisation of the dyeing hue of manufactured lots in comparison with standard prototypes.

With regard to the reproducibility of results with the spectrophotometer, the average deviation for a determination for most colours is about 0.05 per cent., except for yellows and browns, for which it is at least 1 per cent. We report our values to the nearest 1 per cent., and expect that more than half the time a repeat determination will give the same figure and not a value one unit on either side. Stating it another way, a difference in strength between two samples

can be detected with great certainty when the actual difference is even as small as 2 per cent. Such accuracy is better than can be attained with the dyeing method, for which the average deviation of a single dye test is about 2 per cent for the vat colours, and even greater for poorly exhausting colours, such as the direct or sulphur dyes. It may be remarked, however, that routine dye testing is usually carried out with much greater precision than many appreciate.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

It is a pleasure to report a distinct increase in the sale of dyestuffs in January, but this position is an annual one, not necessarily indicating a better state of affairs, as it seems to be connected with end-of-the-year stock-taking in the dyestuff consuming industries. On the other hand, threatened restrictions in India have led to pressure for early delivery of cotton materials, and increase in the China trade may account for some of the increased business. Here, again, however, there is no definite promise of a continued improvement.

The various organisations connected with the cotton trade have been much in the limelight during the month. The conference of the various cotton operative organisations and the Federation of Master Spinners' Associations and the Cotton Spinners and Manufacturers' Associations called to consider the proposals of the employing organisations to reduce wages and lengthen the working time per week, was unable to make any progress other than the establishment of a joint sub-committee to consider the proposals. At the same time the Cotton Yarn Association is advocating its policy of reduction of output, and thus would appear to be in direct conflict with the other employers' organisations. They are not really, but the position is one which it is more easy to get into than to avoid, if parts of the same problem are considered as wholes.

Speeches by various banking institutions deeply involved in the financial side of the cotton problem contain references to the cotton trade which do not appear helpful. It is stated that the Cotton Trade Joint Committee, made up of representatives of every trade and institution which together constitute the cotton trade, has now reported. Much is hoped from the work done by this committee, and the publication of any constructive proposals is very desirable.

The most practical contribution made during the month is that of the Bleachers' Association, which has made a substantial reduction in its charges for cloth in which foreign competition is particularly keen. It is understood that the operatives involved have accepted a reduction in wages as their share of the contribution. It is a very encouraging gesture which, it is hoped, will be gracefully followed by other relatively prosperous finishing organisations.

The profit-sharing scheme of Imperial Chemical Industries, Ltd., is now in full swing, and it is reported that the interest shown in the acquisition of shares, on which the scheme is based, promises great success. Such schemes ought to be very simple and a cheap means of paying for peace in industry.

Yorkshire

Although a distinct improvement on the trade of January of last year, the month just completed has not quite come up to the expectations born of improvement experienced month by month last year and of the spirit of optimism which prevailed just before Christmas with regard to the New Year. In comparing turnovers we should, of course, not forget the big drop in prices of most of our products which has occurred since January of last year. Turnovers have been distinctly bigger, and weights must have been still bigger than prices would at first sight appear to indicate.

For Huddersfield textiles the year opened very encouragingly both for home and export, especially as concerned the fine worsted trade, many mills working overtime regularly and with orders in hand likely to keep them occupied for some length of time. The prospects in the sections of the trade in which nothing but the best cloths are made are stated to be unusually good. There is a strong tendency to go back to quieter styles. French and silver greys and blues are in

good demand, though brown in various shades remains very popular in the second class trade. The heavy woollen district, too, can report some progress, employment in the mills being somewhat better. The best section is said to be the blanket trade. In woollen cloth quieter tones and shades for both men's and women's wear are favoured to-day. A very wide range of greys and fawns are being offered.

The Joint Dyers' Executive met in Bradford on Saturday, January 7, to consider their position in view of their having given notice to terminate all local and sectional wages agreements with the employers. The meeting was adjourned to Monday, January 16, in order to enable the separate Executive Committees to reach final conclusions. Their meeting was held in Manchester. Suggestions for variations in the old agreements were made and these were forwarded to the employers. The result is an announcement by the National Union of Textile Workers that under the sliding scale agreement wages in the dyeing and finishing section of the wool textile industry will be increased by amounts varying from one penny to threepence from the first pay day of February, the employers (the Allied Association of Bleachers, Dyers, and Finishers) having agreed to recommend their constituent federations to continue to observe the sliding scale for the present. The subject affects approximately 80,000 operatives in Yorkshire, Lancashire, Derbyshire and Scotland.

The Colour Index, published by the Society of Dyers and Colourists and received so well alike by dyestuff manufacturers, merchants, and consumers, is to be supplemented by the publication of information concerning old and new dyes not contained in the original volume but which has become available since its compilation. The dyer who is not a part of a big organisation powerful enough to carry on its own research welcomes the information so conveniently conveyed to him, and more than one have expressed to the writer that a more extended classification of the dyestuffs according to fastness to light would be of inestimable value in the absence of any but the somewhat crude comparisons they are able to make on their own premises.

Scotland

The tangible evidence afforded by the improvement in the import and export position towards the end of last year, combined with the more optimistic expressions of opinion on the part of bankers and others, have had a general heartening effect as regards the current year. It is of interest to see whether any progress has been made during January.

On the whole, the general opinion is that, while there has not been much improvement to boast of, the month has not been a bad one for January. In the chemical markets there was a gradual improvement towards the end of the month in the home trade, with a slight set-back in exports. Dyers and printers have remained moderately busy, wool dyers being the best occupied, and dye sales have been steady. Employment in the carpet section has remained good. The tweed manufacturers are now making pattern orders for next winter, and the hosiery section remains moderately well occupied, with overtime being worked in some of the fancy sections. At Dundee the jute and linen position is slightly improved. Jute Industries, Ltd., associated companies sustained a slight loss during the last year; the volume of business secured since last September, however, is stated to have been greater. Another new artificial silk factory is promised for Scotland, the location this time being at Jedburgh.

Rumour has been busy again with the British Alizarine Co., amalgamation with the United Turkey Red Co. having been suggested.

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Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

Fast Dyes for the Ideal Home

VERY convincing evidence of the importance of fast dyes is given at the Ideal Home Exhibition, now being held at Olympia, London. Maple and Co., Ltd., exhibit a completely furnished house, "Sundour House," in which "Sundour" fadeless fabrics are used throughout wherever fabric is needed. A visit to this exhibit is well worth while for the beauty and variety of colours to be seen, which indicate that in this particular line there is a much larger field for the application of dyestuffs than might be suspected. An interesting feature of "Sundour House" is that the walls are not papered or distempered, but covered throughout with "Sundour" cretonne, a point which gave rise to many inquiries. In general, the exhibit shows the important psychological effect of using carefully selected and attractive colourings, while the importance of choosing colours fast to light and other factors is now too well known to need emphasis.

A New Soledon Colour

THE latest addition to the Scottish Dyes series of Soledon Colours is Soledon Black 2B, a deep pure black of which five examples are shown on the pattern card. These consist of silk padded twice in a solution of 1 lb. dye per gallon of water and developed after each padding; of viscose silk padded once in the same liquor and developed; of Soledon Black 2B thickened with dark British gum, printed, steamed and developed; of cotton padded once in a solution of 2 lb. dye per gallon and developed; and wool padded as in the case of cotton.

Methods of Dyeing

IN dyeing, the amount of liquor used can be varied according to the material to be dyed and the type of dyeing machine available. As a general rule, the shorter the bath the better will be the exhaustion obtained. For yarn dyeing in the open beck, twenty times the weight of material is the minimum that can be used. For piece dyeing in the jig, a concentration of eight times the weight of the material is satisfactory.

The dye paste is dredged into the bath through a sieve, and 20 per cent. to 100 per cent. (according to shade) of Glauber's salt crystals or 10 per cent. to 50 per cent. of common salt calculated on the weight of material is then added to the dyebath. Dyeing is commenced at 40°C. and continued for half an hour, while the temperature of the bath is raised to 75°C. The dyeing is then carried on for a further half hour at this temperature, when the material is taken out and squeezed. Wool and silk are dyed at a gentle boil, better exhaustion of the dyebath being obtained than with the lower temperature, although this may be used if desired.

Oxidation Treatment

IN order to develop the shade, the following oxidation treatments are recommended:—

(a) On cotton and linen: The goods are immersed for one minute in cold 2 per cent. sodium nitrite solution. After squeezing well, a further immersion is given for 3 minutes in a bath containing 2 per cent. hydrochloric acid and $\frac{1}{2}$ to 1 per cent. copper sulphate at 75°C.

(b) On wool: For light shades, boiling 1 per cent. potassium persulphate may be used. For medium and dark shades, the wool is immersed for 1 minute in cold 2 per cent. sodium nitrite and, after squeezing, in 2 per cent. hydrochloric acid at 30°–35°C.

(c) On viscose silk: As on cotton, with the exception that the addition of copper sulphate to the acid bath is not necessary.

The addition of 5 lb. common salt for every 10 gallons developing solution is recommended to prevent bleeding and to give increased depth of shade. After development, the material is rinsed free from acid and soaped in a bath containing 10 lb. soap and 5 lb. sodium perborate per 100 gallons.

Soledon Black 2B can be applied also by the usual padding methods recommended for direct cotton colours. The after-treatment is carried out as above. The printing of Soledon Black 2B presents no difficulties. The colour is merely thickened with a suitable gum and printed direct. The goods are subsequently steamed to fix the colour and the shade developed as already stated.

Dyestuffs Licences in February

THE following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during February, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—

The total number of applications received during the month was 659, of which 540 were from merchants or importers. To these should be added 21 cases outstanding on January 31, making a total for the month of 680. These were dealt with as follows:—Granted, 617 (of which 601 were dealt with within 7 days of receipt); referred to British makers of similar products 52 (of which 47 were dealt with within 7 days of receipt); outstanding on February 29, 11. Of the total of 680 applications received, 648 or 95 per cent. were dealt with within 7 days of receipt.

Dyestuff Questions in Parliament

IN reply to the questions recently asked in the House of Commons by Mr. Fenby, the President of the Board of Trade was able to add a little to our existing information. Of the total number of 7,467 applications for licenses to import foreign dyestuffs in 1927, 6,753 applicants were granted, and the balance of 714 presumably refused or deferred. The amount received in fees was £3,439, and the cost of the committee (inclusive of allied services) was approximately £3,800, so that the cost to the public of the licensing system is about £450 a year. On the subject of a certain ink case (in which the American makers use British dyes) the President repudiated the suggestion that this country prohibits the importation of articles treated exclusively with British dyes previously purchased here. Such inks as come within the definition of "synthetic organic dyestuffs, dyes, and colouring matters" are wholly covered, he said, by the prohibition of importation imposed by the Dyestuffs Act. The policy of the Licensing Committee is to refuse to recommend the issue of licenses where they are satisfied that suitable inks of the same kind are obtainable in this country. It may be quite true that the colours used in the ink are of British manufacture,

but the Licensing Committee would require to be furnished with proofs which could not be verified except by considerable investigation, and they have apparently decided not to incur this troublesome obligation but to treat the foreign ink as it stands, as containing "synthetic organic" colouring matter.

Dyes in Small Quantities

THE annual "Census of Dyes and Other Organic Chemicals," published by the United States Tariff Commission, contains a list of the American manufacturers of these products. It does not indicate, however, whether the manufacturer will sell directly to the consumer or only through agents, nor whether he supplies the retail as well as the wholesale trade. So many inquiries were received by the Bureau of Standards as to where particular dyes or chemicals could be purchased that a questionnaire was issued to all manufacturers mentioned in the 1926 Census. As the result, a list of 42 American firms who "will sell one ounce or more direct to consumer" has been circulated. Among these appear the names of W. J. Bush and Co. and the Monsanto Chemical Works.

International Dye Tests

THE Research Committee of the American Textile Chemists and Colourists report a certain amount of progress towards international co-operation in the establishment of standard methods of dye testing. Since January 12 communications have been forwarded to thirty-seven different members of foreign committees, together with the most recent reports of various fastness committees. It was suggested that these reports be studied critically and that suggestions be returned in order that they might be given consideration in a revision of the methods which it is proposed to make previous to the publication of the Association's 1928 Year Book. The chairmen of all sub-committees were urged to study their reports in the light of suggestions already made, and also with the consideration in mind of international co-operation. It was further suggested that additional types of fastness, such as fastness to rubbing, crocking, kier boiling, cross dyeing, and others, should be worked out in order that the methods published in the next year book might be as complete as possible.

A Standard Laboratory Washing Machine

AT present samples of printed fabrics and dyed cotton material are being subjected to a series of standard laundry treatments, and when these are completed the results will be studied in relation to the present Association tests for washing, with the object of correlating the results of the actual laundry tests with the laboratory methods. The matter of a standard washing machine has been discussed, and it is the opinion of the committee that the chairmen of the various sub-committees on fastness to washing should formulate specifications for a standard type of laboratory washing machine for satisfactorily carrying out these tests. Two machines, somewhat different in construction, have been used by members of these committees and both have been found to give satisfactory and concordant results. In one case, the jars containing the samples which were being subjected to the washing test were heated in an air bath, and in the other machine in a water bath. The opinion was expressed that if either type of apparatus appeared to be more practical than the other, it should be adopted as the standard, rather than recommending two different types of machines. It was also proposed that when such standard specifications had been adopted a number of machines should be made and sold under the supervision of the Association.

Progress was also reported in the endeavour to gather data for a complete list of pre-war prototypes of such dyes

as have appeared in previous Year Books, but not assigned to any Schultz or Colour Index numbers. It was reported that there was every reason to believe that such a list could be completed in time for publication in the 1928 Year Book.

The New Age of Colour

THE revolution in the use of colour, which is one of the distinguishing features of to-day, is cheerfully described by an American writer in the *Saturday Evening Post*. "Everyone," he states, "who sees sumptuously staged spectacles and revues must have been impressed both by the new colour sense characteristic of the best contemporary scenepainting and by the unprecedented beauty of the costumes. The dyeing of textiles, whether for stage use or common wear, has made prodigious advances, and every familiar colour has been transformed by some small but vital change which has imparted to it new life, charm, and interest. One need not leave his own fireside to observe equally striking signs of the new invasion. Hangings, draperies, and floor coverings tell the same story. The craze for coloured glassware for table and parlour use has produced new hues and effects. Even the humble agate ware of pantry and kitchen refuse to be denied a part in the general symphony of colour. Motor cars are borrowing their hues from the waters of the Nile, from the sands of Arabia, from the plumage of birds, and from the fire of gems. Everything that woman wears shares the new legacy of colour.

"Neither progressive manufacturers nor a receptive public can claim the greater share of credit for ushering in our new age of colour. This must be assigned to our chemists, laboratory men, and researchers. They have worked so quietly and so obscurely that we scarcely realise what a variety of new substances and materials of which to make articles of common use they have brought into being. It is characteristic of many of these new products that they are light, strong, and susceptible of a bland polish. Moreover, they can be permanently and artistically coloured. Again we must thank the chemists for liberating scores of new hues from the gummy darkness of coal tar and other plentiful substances. We must pay homage to their success in elaborating new bases and solvents for the modern lacquer paints which carry the novel hues so effectively and help to brighten a dingy world. We are materially richer for a whole series of such products which combine utility with beauty and not only withstand wear, weather, and rough usage but have a patina which is equally agreeable to the eye and to the touch."

Dyes for Foodstuffs

THE recommendations (a *Times* correspondent remarks) of the Departmental Committee on the use of preservatives and colouring matter in human foodstuffs, whilst not having the force of law, have, nevertheless, attracted much attention and have caused the manufacturer of dyestuffs for foodstuffs to take careful stock of his position. Whilst it is not for one moment suggested that the dyestuffs hitherto available have been in any way harmful, it is, however, strongly desirable that they should be made to conform to some accepted specifications of purity, and colours backed by a definite guarantee should be available.

The exports of dyestuffs from Great Britain in 1927 were, on the basis of the information available, at the rate of 3,128 tons per annum, an increase of 16.8 per cent. in comparison with 1926. The licensed imports were at the rate of 2,026 tons per annum, in comparison with 1,892 tons in 1926. This increase is caused partly by increase in trade and partly from the introduction of new products. During the year the Imperial Chemical Industries, Ltd., began to function actively, and that brought about close co-ordination in sales of dyestuffs and of other products used by dyers.

Dyes and Their Application : The Mordant Colours

By L. J. Hooley

Our correspondent deals this month in considerable detail with the important subject of mordant colours. Mordanting, which was formerly chiefly of interest as a mode of dyeing, has latterly come into prominence on account of its important relation to the problem of securing increased "fastness." Dyestuff chemists especially will appreciate the technical and patent information embodied in the article.

Mordant Dyes

THE general heading of mordant dyes covers a class of colours that is of particular interest for its historical importance, the variety of its members, and the nature of its application methods. The earliest dyestuff, as far as is now known, was a mordant colour. A large number of the natural dyestuffs belong to this class. Their number and types have been greatly increased by the addition of synthetic products, and the discussion of their constitution brings them into the foreground of the most recent valency theories.

It was the fact of many of the older dyes belonging to this group that accounted for the relative high fastness of much of the old-time dyeing, while the empirical nature of the processes was particularly favourable to the growth of complicated and secret recipes, which were once such a feature of the art.

At the present time all the mordanting methods cannot be considered together. While under the general heading it is necessary to include the basic colours, which are fixed on cotton with a tannin mordant, the tannin process is generally considered as being of a different nature from that with metallic mordants.

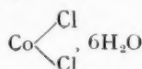
Initially, mordanting was of more importance as providing a mode of dyeing rather than as increasing the fastness of the resulting product. At the present day, however, it is the latter aspect that is of most importance; otherwise with the growth of the synthetic substantive colours, the mordants must have fallen into comparative disfavour, because of their greater difficulty in dyeing.

Alizarine

Alizarine is, of course, the most important of the mordant colours, as well as being unsurpassed in fastness. Alizarine itself can be dyed on cotton from a vat instead of with a mordant, but the colour can easily be soaped off again. It can also be dyed directly on to wool from a slightly acid bath, but the shade is of no interest. It, however, gives quite a satisfactory orange on acetyl silk. The naturally occurring organic products function as mordant colours in the same way as the alizarines, through their hydroxyl and carboxylic acid groups. Examination of all the commercial alizarine dyes shows that in every case there are two hydroxyls in the same positions as in alizarine itself, as pointed out by Liebermann and Kostanecki. It is now realised that for scientific purposes this is only an approximate rule, as several of the hydroxy anthraquinones, including mono-oxy anthraquinone, form definite mordant compounds. It has also been recently found that naphthazarine has the quinizarine and not the alizarine structure.

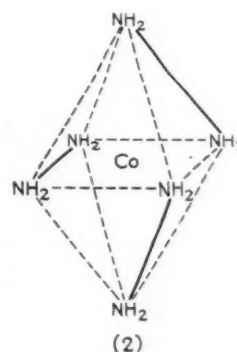
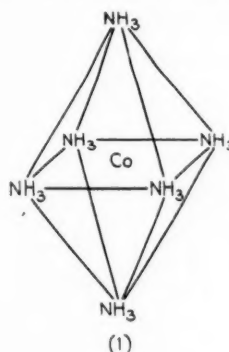
Method of Combination Between Mordant and Colour

The way in which the metallic compound combines with the dyestuff has always been a matter of uncertainty. If the present ideas on the subject are correct, this is hardly a matter of surprise, as the modern method of formulation is one which is essentially new. It has its basis in the views of valency put forward primarily by Werner twenty to thirty years ago, and which now, largely as a result of the modern developments in atomic physics, are coming into general recognition. On the old views a large number of compounds which did not obey the ordinary laws of valency were classed under the general heading of "molecular compounds," and explanation stopped at this. Particularly good examples from the ordinary point of view are afforded by the salts containing water of crystallisation. In a compound such as cobalt chloride $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ the method of formulation was:



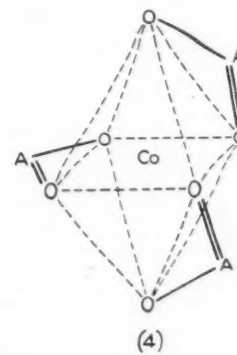
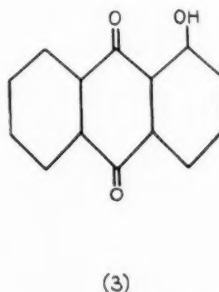
but how the six molecules of water were united, either to each other or to the cobalt chloride, was left undecided. Familiarity with this method of representation, however, disguised the very real gap in the theory of valency which it indicated.

Instead of "water of crystallisation," ammonia will form "ammonia of crystallisation" as the compound $\text{as-CoCl}_2 \cdot 6\text{NH}_3$. An analogous radicle $\text{Co}(\text{NH}_3)_6$ may be taken to show Werner's method of formulation, this being of direct interest for the present purpose.



Werner represents the six ammonium residues as placed at the six corners of a regular octahedron, with the cobalt in the centre. It is this type of arrangement which is assumed to hold in the case of the metal in many mordant compounds.

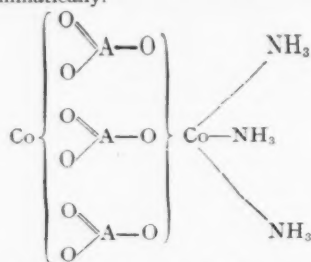
Instead of the radicle $\text{Co}(\text{NH}_3)_6$ there is a similar type $\text{Co}(\text{HN}_2-\text{NH}_2)_3$ containing three double groups instead of six single ones. In such a case, each double group occupies two corners of the octahedron. Such a group, which occupies two positions in a compound of this type, has been named by G. T. Morgan a "chelate" group ("chela"—a claw). When we come to dyestuffs, we have three dyestuff molecules each occupying the position of one of the HN_2-NH_2 groups. Thus three molecules of hydroxy anthraquinone may be joined, each through the two neighbouring oxygen atoms as shown in (3) and (4).



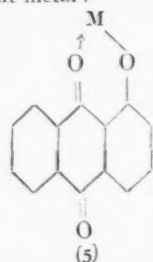
In (4) the oxygens only are shown, the remainder of each anthraquinone being represented by the letter A.

G. T. Morgan and J. D. Main Smith have described a large number of compounds of this type (*J. Soc. Dy. C.*, 1925, page 233), most of them of very complex structure. In the case of alizarine, where there is a second hydroxy group in each molecule, these three extra groups can replace three of the six positions in a second cobalt compound, the remaining

three being occupied by NH_3 groups. This may be represented diagrammatically.



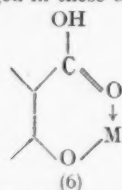
If we return to the single anthraquinone nucleus, it is not immediately clear how junction takes place through the middle oxygen atom. This may be represented in more than one way. Sidgwick and Callow (*J.C.S.* 1925, 527) do it as follows, where M is the mordant metal:—



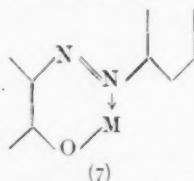
The significance of the arrow instead of the usual bond, is connected with the way in which the link is first formed, rather than with any difference once it is formed. The ordinary type of non-ionic linkage is considered as being formed by two electrons, one from each atom; this is represented by the single bond. There is also another type in which both electrons come from one atom; this is represented by the arrow (which begins on the atom which supplies the two electrons). Once the two linkages are formed, they are possibly identical. There is evidence, independently of the question of mordants, for this mode of representation, and anthraquinone 1-hydroxy can itself be formulated as in (5).

This has the rather surprising appearance of making hydrogen divalent, but the fact that the second junction is effected by electrons coming from the oxygen alone partly reconciles this with the older ideas.

The merit of this way of representing the anthraquinone mordant compounds is that it brings them into line with the other classes of mordants, including the azo-mordants. These practically always contain a hydroxy group, either ortho to a carboxylic acid, as in those where salicylic acid is one of the azo constituents, or else ortho to the diazo linkage, as in the ortho hydroxy azo dyes. The linkage to the metal can be arranged in these cases analogously to that already given.



Salicylic acid.—



o-hydroxy azo.—

Sidgwick points out ("Electronic Theory of Valency") that of some 160 dyes in Schultz, which can be mordanted with poly-valent metals, all but half a dozen or so are capable of being formulated in this manner, with chelate rings containing either five or six atoms. Among the examples given by Morgan and Main Smith there are, in addition to the types described above, nitroso naphthols, azo pyrazolone colours, dihydroxy azo dyes, chromotropes, etc. The examples given under alizarine do not include the actual alizarine red lake, which is a complex alizarine-aluminium-calcium complex; they only give an indication of the mechanism of the lake formation.

The production of lakes for pigment colours is, of course,

allied to the dyeing of mordants, except that the problem is often simpler, being concerned primarily with the production of the colour in an insoluble form, and is not complicated by the necessity for the product to be one that can be held by the fibre. While many compounds may be used for both purposes, lake forming for pigments often consists of the formation of an insoluble metallic salt of a carboxylic or sulphonic or phenolic acid group.

The compounds already described are not, of course, salts; the metal is in many cases extremely difficult to remove, much more so than in the case of ordinary salts. Probably in many cases of after-treatment with copper or other salts, where there is no change in shade, something of a similar nature takes place to that in lake making.

In the acid alizarine series, the colours can be used with mordants, but are not in practice, because one of the primary features of this series, the brightness, is spoiled by the chroming process. Blue Black B is, of course, applied with a chrome mordant to give the requisite shade.

An interesting case is that of the alizarine cyanine greens. These have excellent fastness to light, but are made faster to washing and fulling by after-chroming. The shade is not affected or only very slightly so. Here the only obvious points of attachment are the sulphonic acid groups. When the metal forms part of a ring, as has already been indicated in the previous formulae, it does not have the same tendency to make the compound insoluble as when combined in the ordinary way with an acidic group; as a result, these mordant-compounds can be synthesised apart from the fibre and still remain sufficiently soluble to be dyed, as in the recent and well known Neolan series. In addition to the advantage of eliminating the mordanting stage in dyeing, such dyes are not sensitive to metals in the dyebath, traces of which may in other cases soon ruin the shade.

As already mentioned in these columns, a large number of new soluble metal compounds, chiefly azo colours of this type, are being made at the present time. All the usual metals—chromium, iron, aluminium, tin, zinc and copper—are employed. Many variations can be introduced in the syntheses, including the use of more than one metal, the addition of metal at more than one stage of the process, and the production of compounds which, while already containing metal, may in addition be further mordanted in the dyebath. Some of these products not previously mentioned are given below, where the constituents used and the methods employed will be seen to illustrate some of the points in the foregoing.

E.P. 247556 (S.C.I.B.). Nitrated o-hydroxy diazo compounds are coupled with α -naphthylamine derivatives and then treated with trivalent chromium compounds. The treatment with chromium is carried out by boiling in aqueous solution for 24–48 hours in the presence of glass powder and the dye salted out. An example gives dark olive green shades on wool.

E.P. 260830. (S.C.I.B.). The chromium is introduced into azo dyes by treatment with chromic chromates.

E.P. 257820 (S.C.I.B.). The azo dye from 6-nitro-2-amino-phenol-4-sulphonic acid is treated with chromium, the dye-stuff being separated by evaporating and salting out, giving reddish black shades.

E.P. 247694. (Knecht and Muller). Substantive cotton colours are converted to zinc and magnesium compounds, which are soluble in water by the action of salts of the metals in presence of ammonia or amines.

E.P. 249884 (S.C.I.B.). Compounds from sulphonated 2-diazo-1-naphthol-8-sulphonic acid coupled with other components are treated with copper or chromium derivatives.

E.P. 272908 (I.G.F.A.-G.). In the case of metal compounds that do not dissolve in water, the formation of the mordant is done in an organic solvent, with the metal present, as, for example, the formate, and if necessary, with the application of pressure.

E.P. 269522 (I.G.F.A.-G.). An azo dyestuff is treated with insufficient chromium to combine with all the mordantable groups and the products used for dyeing.

E.P. 272949 (I.G.F.A.). Incompletely chromed dyestuffs, such as those in the patent above, are afterwards treated with copper. Alternatively, the compounds may be first treated with insufficient copper, or with copper and chromium together.

Other mordant dyes are also dealt with in the following:—
E.P. 245865 (B.D.C. and Saunders, K. H.). *o*-Hydroxy carboxylic acid sulpho chlorides are reduced to sulphinic acids and then condensed with nitro compounds to give sulphones. The nitro sulphones are then reduced to amino sulphones, diazotised and coupled to give dyestuffs in which the mordant group is screened from the chromophore group, so that chroming does not substantially affect the shade.

E.P. 266561 (B.D.C., Saunders, K. H., and Goodwin, H.). 1-amino-2-hydroxy-6-sulpho-4-naphthoic acid is coupled with

naphthols, to give bluish chrome colours suitable for printing.

E.P. 262243 (B.D.C., Mendoza, M., and Saunders, K. H.). The sulphones mentioned above are used as end components in the production of other azo dyes. Shades from yellow to blue unaltered by chroming may be obtained.

E.P. 262243 (B.D.C., Mendoza, M., and Saunders, K. H.). Sulphones similar to those previously mentioned but containing two amino groups are used.

E.P. 259797 (S.C.I.B.). Barbituric acids are coupled with *o*-hydroxy azo dyes.

Basic Intermediates for Dyestuffs: No. XVI.—Xylidines and ψ -Cumidine

By "Consultant"

THE introduction of refinements into the construction of modern rectification units has made the isolation of the xylene fraction of the tar distillation products a comparatively simple matter. Even so, it is not possible to separate the three isomeric xylenes from one another, although their separation from toluene and pseudocumene is almost complete. The raw material, therefore, for the manufacture of the xylidines is a mixture of ortho-, meta- and para-xylenes with a quantity of ethylbenzene, and, of course, small amounts of toluene and ψ -cumene. Fortunately, the separation of the xylidines into their various isomers is not often necessary for the preparation of dyestuffs. The composition of commercial xylene distilling between 138–142° C. is:

Paraxylene	60 per cent.
Metaxylene	22 "
Orthoxylene	16 "
Ethylbenzene	2 "

It is usual to nitrate this mixture without any previous treatment, using a small nitrating pan of cast iron of some 800 gallons capacity. The pan (see Fig. 1) is fitted with

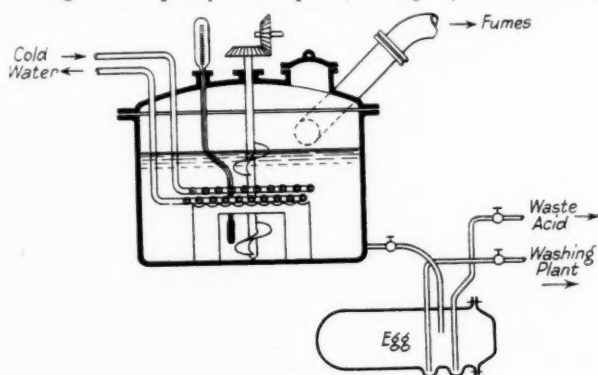
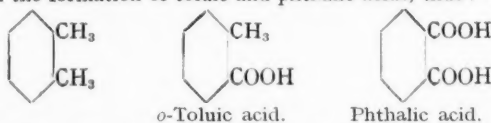


FIG. 1.

chemically pure lead heating and cooling coils, thermometer, and stirring gear. It is particularly necessary that the stirring gear should be highly efficient, as the temperature must be kept lower than when nitrobenzene is being produced, owing to a tendency towards oxidation of the methyl groups with the formation of toluic and phthalic acids, thus:



This being so, very efficient stirring is necessary in order thoroughly to emulsify the mixture. The xylene (250 galls.) is blown into a measuring tank on the floor above the nitrators, and meanwhile the acids are measured into the nitrators from their respective eggs. For the xylene specified, 1 ton of nitric acid (s.g. 1.43) and 1½ tons of sulphuric acid (98 per cent.) are required. The mixing will have raised the temperature of the mixed acid to 35–40° C., but although the stirrer is

started, the xylene is not run in until the temperature has dropped to 30° C. As soon as some 20 gallons of xylene have been run in, cooling is started by water circulating through the coils and the temperature is maintained just below 20° C. until the end of the nitration. This point is determined by sampling the mixture and testing the mixed acid by the nitrometer; at the end of the nitration not more than 1 per cent. of nitric acid should be present. At this point, stirring is stopped and the lower layer of the waste acid allowed to run into the nitrator egg and blown to the acid recovery plant. The upper layer of crude nitroxylene is blown into water and washed in the usual way.

Thus prepared, nitroxylene contains five out of the six possible isomers—the 1:3:5-product being the only isomer which is not capable of production by direct nitration. The physical properties of these five isomers are given below in Table I.

TABLE I.

Constitution.			B.P.	Density.
CH ₃	CH ₃	NO ₂		
1	2	3	240° C./760 mm.	1.147 (15° C.)
1	2	4	254° C./748 mm.	1.139 (30° C.)
1	3	2	225° C./774 mm.	1.112 (15° C.)
1	3	4	237° C./760 mm.	1.135 (15° C.)
1	4	2	238° C./739 mm.	1.132 (15° C.)

It is, of course, impossible to separate these compounds, and they are reduced to "xylidine" by means of iron dust and hydrochloric acid, in exactly the same way as the reduction of nitrobenzene to aniline is carried out. The composition of the crude xylidine approximates to the following:

<i>m</i> -4-Xylidine	40–42 per cent.
<i>p</i> -Xylidine	30 "
<i>m</i> -2-Xylidine	2–7 "
<i>o</i> -3- and <i>o</i> -4-Xylidine	20–25 "

As such it may be used for the production of ψ -cumidine, Sudan II, and Ponceaus R, G and CR; but for the preparation of dehydrothioxylidine, comparatively pure *m*-4-xylidine is necessary, also for the preparation of Palatine Scarlet A, Ponceau 2R and all azo dyes in which xylidine is a first component. The *o*-xylidine is used for the preparation of certain Bordeaux X shades, and the *p*-xylidine for the manufacture of disazo dyes, in which it forms a middle component.

Separation of Xylidines

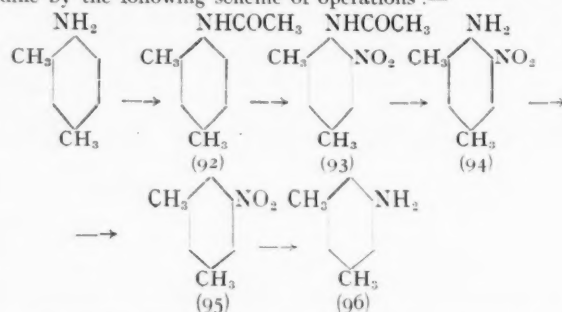
There are three separations practised, the one chosen varying with the purpose for which the final product is to be used. Where *p*-xylidine is the first consideration, the crude xylidine is saturated with sulphur dioxide and the crystals which form removed by centrifuging. The oil is again saturated with sulphur dioxide and the crystals removed as before. The yellow crystals are a complex compound between the xylidines and sulphur dioxide, but the residual oil consists almost entirely of the SO₂ compound of *p*-xylidine. It is distilled in superheated steam after the addition of alkali. The yellow crystals contain the SO₂ compounds of the other xylidines, which can be obtained from them in the same way. Another method for the separation of the *p*-xylidine from the others consists in sulphonation. The xylidine (1 cwt.) is treated with 20 per cent. oleum (3.75 cwt.) at 80–100° C. until a greenish solution of the monosulphonic acids has been formed. The whole is poured out into water, neutralised with milk of

lime, filtered, and the calcium precipitated by the addition of sodium carbonate. On evaporation of this solution the *p*-xylylene sulphonic acid crystallises out, leaving the other isomeric xylylene sulphonic acids in solution. The *p*-xylylene may be regenerated from its sulphonic acid by dry distillation. The xylylenes in solution may also be regenerated—in this case, by heating with sulphuric acid.

Probably the best method of effecting a complete separation of the five isomers on a large scale is as follows. Reference to Table II shows that of *m*-4- and *p*-xylylenes have sparingly soluble hydrochlorides so that a preliminary separation is made by this means. Crude xylylene is treated with five-sixths of its weight of commercial hydrochloric acid diluted with half its weight of water. The hydrochlorides of the *m*-4- and *p*-xylylenes separate out and may be filtered from the more soluble hydrochlorides of the *o*-3-, *o*-4- and *m*-2- isomers, and washed with 20 per cent. hydrochloric acid. The two fractions are regenerated by the use of alkali and steam distillation. The fraction from the insoluble hydrochlorides contains about 60 to 70 per cent. of *m*-4-xylylene, and 30 to 40 per cent. of *p*-xylylene. It is stirred with one-third of its weight of glacial acetic acid, a quantity sufficient to convert the whole of the *m*-4- isomer to its acetate, which latter crystallises out almost completely in the course of a few days. It is centrifuged from the mother liquor, washed, and the *m*-4-xyli-

ne to crystallise and the *m*-2-xylylene sulphate removed and regenerated in the usual way. The *o*-3 and *o*-4 isomers are separated by taking advantage of the differences of solubility of the hydrochlorides.

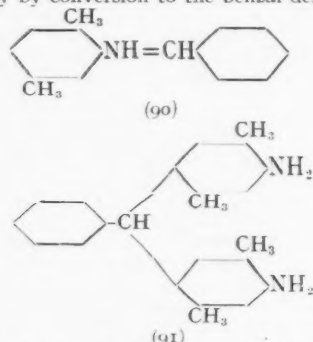
When required, 3:5-xylylene, which cannot, of course, be prepared by direct nitration, may be prepared from *m*-4-xylylene by the following scheme of operations:—



The acetyl derivative of *m*-4-xylylene is nitrated in the 5-position (93), the corresponding nitroxylylene (94) regenerated and the amino group removed by the diazo reaction, thus

Xylylene.				TABLE II.			Acetyl Derivative.		Solubility of the Hydrochloride in Water.
CH ₃	CH ₃	NH ₂	Synonym.	M.P.	B.P.	S.G.	M.P.	Description.	
1	2	3	<i>o</i> -3-xylylene	—	223° C./739 mm.	0.991 at 15° C.	134° C.	White needles	Soluble.
1	2	4	<i>o</i> -4-xylylene	49° C.	224° C./728 mm.	1.077 at 17.5° C.	99° C.	Long needles	Very soluble.
1	3	2	<i>m</i> -2-xylylene	—	216° C./735 mm.	0.980 at 15° C.	177° C.	White	Soluble.
1	3	4	<i>m</i> -4-xylylene	—	216° C./728 mm.	0.918 at 25° C.	129° C.	White needles	Sparingly soluble
1	3	5	<i>m</i> -5-xylylene	—	220° C./—	0.922 at 15° C.	141° C.	Large	9.2 g. in 100 at 18° C.
1	4	2	<i>p</i> -xylylene	15.5° C.	214° C./762 mm.	0.980 at 15° C.	139° C.	Long	Soluble.
									Sparingly soluble, 11.2 g. in 100 at 18° C.

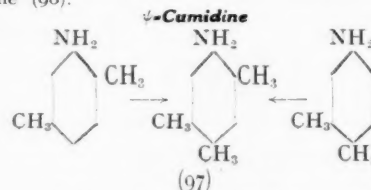
dine regenerated in a comparatively pure state. The mother liquor from the separation of *m*-4-xylylene acetate is treated with a quantity of hydrochloric acid equal to one-ninth of the weight of the original mixture. The hydrochloride of *p*-xylylene which separates out is removed by centrifuging, washed and converted in the usual way to *p*-xylylene. This is still only about 90 to 95 per cent. pure, but may be obtained in a high state of purity by conversion to the benzal derivative (90).



The crude *p*-xylylene is warmed at 100° C. with an exactly molecular proportion of benzaldehyde. The *p*-derivative gives a benzal derivative which readily crystallises (m.p. 102–3° C.) but the impurities and their benzal derivatives remain liquid. The comparatively pure benzal derivative of the *p*-isomer can therefore be separated by centrifuging. It is regenerated to pure *p*-xylylene by steam-distillation in the presence of hydrochloric acid, when the benzaldehyde is split off and removed. When this section of the reaction has been completed the hydrochloride liquor is made alkaline, and the *p*-xylylene steamed out. A quantity of the substance numbered 91 above remains behind (m.p. 205° C.).

There remains the separation of the *m*-2-, *o*-3, and *o*-4 isomers to be considered. The mixture of these three is treated with the necessary amount of 30 per cent. sulphuric acid to convert it completely to the sulphates. The sulphates of the *o*-3- and *o*-4- isomers separate almost quantitatively, and may be filtered off from the liquor containing the *m*-xylylene sulphate. This liquor is concentrated to a syrup, allowed

leaving 5-nitro-*m*-xylene (95) which on reduction give *m*-5-xylylene (96).



The compound ψ -cumidine, which finds use both in the manufacture of bromocumidine and as a component in azo-dye preparation, may be prepared from crude xylylene. Only *p*-xylylene and *o*-4-xylylene give rise to ψ -cumidine (97), but it can be readily separated from other products.

The crude xylylene is converted to its hydrochloride and heated with an excess of methyl alcohol to 300° C.; when the reaction is completed and the autoclave is cool, pressure is released, and the whole stirred with 20 per cent. nitric acid. The nitrate of ψ -cumidine is relatively insoluble and may be filtered off and washed. The ψ -cumidine can then be regenerated with alkali and redistilled. The product which distils between 230° and 240° C. is collected.

A Book on Artificial Silk

As far as patents are concerned artificial silk literature is rich, but in authentic published information it is poor. Any writer, therefore, who adds some reliable information is doing a public service. To this category belongs *The Manufacture of Artificial Silk*, by E. Wheeler, just published by Chapman and Hall (Pp. 150. 12s. 6d.) It collates much patent literature and also describes some manufacturing methods which have been applied in practice. It is primarily intended for those chemists who wish to obtain a bird's-eye view of the present state of our knowledge of artificial silk. The book contains descriptions of the manufacture of viscose, cuprammonium silk, Chardonnet's silk, and acetate silk, and in addition of gelatine silk and a few other insufficiently developed processes. The reader will find in it particulars of the present-day methods as defined above, the aims and trend of this industry, the properties of its raw materials, and a very brief statement of the analytical methods employed.

The Dyeing of Leather

Differences in British and Continental Methods

MR. M. C. LAMB, of the Leathersellers' Technical College, has made an interesting contribution to the literature of leather dyeing in his paper on "The Dyeing of Gloving and Clothing Leathers." He stated in his paper that leather for clothing had only become common since the advent of the motor-car, except in Canada, where climatic conditions influenced its adoption in winter months. As an article of fashion, demanded in any colour which the feminine gender might require, the leather dyer's art was likely to be more extensively employed in the future when dealing with light leathers. The colouring of leather for gloves or clothing, he continued, must fulfil several important requirements; the colour must be reasonably fast to light, as, apart from wear, gloves had to stand reasonable exposure to light in shop windows and elsewhere where they were displayed for sale. The colour must be fast to both rubbing and perspiration, as a large number of gloves were made unlined.

Various Methods of Dyeing

As regards the method of colouring practised in Great Britain, this varied materially from Continental procedure. Whilst England had until recently devoted its attention to the manufacture of leather which was probably more suitable for men and the heavier type of women's wear, German, Austrian, French and Czechoslovakian manufacturers mainly specialised on the production of finer leather for ladies' wear, the colouring of the latter being done on the grain surface only, leaving the flesh side the natural colour of the leather. The dyeing of alum glove leather in Great Britain was chiefly confined to complete immersion in the dye bath by drumming, but on the Continent the colouring was done by brushing the dyestuff on each individual skin. This variation of procedure necessitated different methods of treatment as far as the preparation of the leather was concerned, previous to carrying out the colouring processes.

Mr. Lamb outlined the various methods employed in the production of light leathers such as the alum tannage, chrome, etc., giving full instructions and recipes for the various styles. Mention was made of "ageing" alum leathers, which had the effect of making the alum salt more insoluble, and less liable to the removal by the wetting back and dyeing processes. He stated that, dependent on the length of time the goods had been stored, they would either wet back easily or with difficulty, and there would be a material loss or otherwise of the tanning agent, with the consequence that the goods would dry either soft or hard after the dyeing operations had been effected.

Dyestuffs Non-Fast to Ironing

An Interesting German Investigation

THE change in the colour of dyestuffs when they are brought into contact with hot metallic surfaces is particularly manifested in the case of cotton dyeings. Many investigations have been carried out with the intent of discovering just why this happens. Some have believed that the non-fastness of the dyestuff to ironing is due to the possible existence of two forms of the colour—namely, a water-containing form and an anhydrous form. Nevertheless, there are instances which appear to contradict this theory. Thus, when Diamine Blue 3R is employed in an aqueous solution, the colour of the dyestuff is changed into a reddish shade when the solution is boiled, and vegetable fibres may be dyed a currant-red with this solution. All dyestuffs that yield such dyeings form two phases of different degrees of dispersion, of which the higher dispersed form dyes animal fibres a corinth red and the lower dispersed form dyes vegetable fibres a blue.

An investigation has been made in Germany on this subject, and upward of thirty of these dyestuffs have been tested. They belong principally to the blue and violet benzidine colours. Keeping the dyestuff in a desiccator over sulphuric acid generally induces the same phenomena, particularly in the case of the blue and violet shades.

Two Different Forms of Dyestuff

The following observations have been made on the behaviour of the solutions of dyestuffs: Fractional precipitation with the aid of electrolytes, such as sodium chloride, separates the

lesser dispersed portion of the colour. A blue precipitate is thus formed, while a currant-red filtrate in which cotton can be dyed remains. The different portions of the dye solution may also be separated with the aid of adsorbents. Ultra-filtration of the aqueous solutions often gives a reddish filtrate. The presence of two different pigments is also particularly clearly manifested in the case of such dyestuffs as Oxydiamine Blue R, Oxamine Blue 4R, Brilliant Azurin B and Diamine Brilliant Violet B, when they are subjected to capillary experiments. The limits between the two zones formed is sharply defined. Barium sulphate or alumina can be used as the adsorbents. It has also been found that there is a very definite ratio between the degree of distribution of the colour between the adsorbent and the medium from which the dyestuff is adsorbed. There is also a definite relationship between the surface area of the adsorbent and that of the dispersed phase of the dyestuff in solution which affects the result of the adsorption.

The same behaviour is observed in the case of the spun fibres. In addition to the external surface area of the fibres the inner area also plays a very important role. Differences in the magnitude of these surfaces are responsible for the blue colouring of cotton and the red colouring of wool in the dye liquors containing the aforementioned colours and their like. The results of the investigation allow the conclusion to be drawn that the woollen and the acetate fibres possess a greater internal surface area than cotton. Furthermore, the dyeings carried out with the aforementioned dyestuffs possess all the characteristics of substantive cotton dyeings. When a mixture of cotton and wool is boiled together in the dye liquor, the latter is coloured a deep blue and the former a red.

New Liquid Mulsoids

EVERY industry to-day is finding that progress can only be made through the application of scientific principles to its processes. Although some of the oldest operations practised by man, the processes of washing and scouring the many varieties of textile materials have not been the subject of scientific inquiry until the last few years.

One result of recent textile research has been the development in England of the well-known laundry and textile detergent and finishing agent, Mulsoid. Recently a further advance has been made in Canada in the production of Mulsoids in liquid form. As first produced, the various types of Mulsoid were pastes which had to be creamed with water for use. Under some circumstances this was found to be a disadvantage, and after several months' investigation, involving hundreds of experiments and tests, a satisfactory liquid product has been developed. The liquid Mulsoids mix instantly with warm or cold water and are therefore much easier to use than even soap or soda, which have to be dissolved in water.

The two chief features of the paste Mulsoid were the unique grease solvent properties and the splendid finish imparted to the goods treated with it.

These properties are enhanced in the new product, as liquid Mulsoids are not the former paste Mulsoids let down with water into creams, but entirely new combinations of the same constituents in greater concentration, thus giving a more "active" product.

In the textile mills finish is of supreme importance. Woollen and flannel goods scoured in a Mulsoid bath have a softness and fluffy nap obtainable in no other way. The results obtained in knitting mills on art silk and rayon goods are remarkable. More even dyeing, soft feel and handle, and perfect sheen make Mulsoid treated goods outstanding in quality and selling appeal.

Suitable brands of liquid Mulsoid have been developed for the laundrymen, to whom its detergent properties are of special value, particularly for the washing of delicate rayon fabrics. On account of the finish imparted to the goods, the results obtained in the washing of woollens and flannels are of special interest to the laundryowner as no other goods so well show the quality of his work.

Although liquid Mulsoids contain some of the most powerful grease solvents known, they are absolutely harmless to any fabric or to any colour. The constituents are most carefully balanced and incorporated under scientific control.—*Canadian Colorist.*

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

The demand for dyestuffs in February was somewhat better, probably in sympathy with the better trading conditions prevailing during the month in the various phases of the cotton industry. With regard to the latter improvement, it is reported that the China market has improved considerably with more settled conditions, and the importance of this enormous cotton consuming market, when normal, to Lancashire trade cannot be emphasised too much in any survey of the general position.

The month has seen little progress in the task of putting the cotton trade's house in order; action in the proposed lengthening of hours and lowering of wages has been deferred; no amalgamation or re-organisation has materialised, despite many rumours. Probably a continuation of better trading conditions would create the atmosphere needed for the growth of constructive ideas.

The Bradford Dyers' Association's report would not appear to have met the expectations of shareholders, but has undoubtedly created envy among those engaged in the less fortunate phases of the cotton industry. A similarly good report is anticipated in the case of the Calico Printers' Association.

Now that the British Dyestuffs Corporation, Ltd., is merged in the I.C.I., it is probable that the British Alizarine Co.'s report will be the only one to be made public, and while it is unsafe to judge the position of an industry on the report of one concern dealing largely in a monopoly, its profit suggests that the British dyestuff industry earned profits during 1927.

A short note in the daily press has confirmed the rumours that the arrangement between the British Dyestuffs Corporation, Ltd., and the North British Chemical Co., whereby the latter ceased to manufacture dyestuffs, has led to a disagreement which is apparently to be fought out in the courts. It is reported that the two firms disagree on the interpretation of certain terms of the arrangement.

There is still no confirmation of the long continued expectation of the absorption of the British Alizarine Co., by the I.C.I.

Yorkshire

The Yorkshireman connected with the dyestuff trade and a regular visitor year by year to the British Industries Fair, having observed the gradual diminution of total exhibitors in his section, this year notes with satisfaction that his county was well numbered amongst the die-hard exhibitors—L. B. Holliday, and Co., Ltd., J. W. Leitch and Co., Ltd., Hickson and Partners, Ltd., and Brotherton and Co., Ltd. Although the last-named manufacture their colours at Birkenhead, Leeds claims the company as its own, but it would be somewhat presumptuous on the part of the Yorkshireman to claim the exhibit of the Imperial Chemical Industries, Ltd., as a point exclusively in favour of his county.

The shrinkage in number of Yorkshire exhibitors must not be attributed to shrinkage of the industry in Yorkshire, for the firms who have from time to time exhibited are, all of them, still actively turning out dyestuffs, despite the price factor and other devices employed by the patriotic but "business first" colour users to weaken the protective power of the Dyestuffs Act. Yorkshire cannot be said to have derived much in the way of immediate and concrete orders, but it is not disappointed, for its previous experience has taught it not to expect them. Rather has it been the object of the exhibitors to show to the buyer from overseas that England still has a dyestuff and intermediate industry in which a number of old-established English firms take a prominent part, and to trust that such showing will in due season bring inquiries and orders.

The price factor has been referred to above, and in connection with this it might be well to mention the view of one of those Yorkshire makers who have exhibited but are not showing this year. It is that to be just to home manufacturers the factor should be based on the pre-war price ruling in Germany and not on that ruling in Great Britain, which was, in most instances and as everybody knows, a dumping or excess production figure.

Trade continues to maintain its improvement over that of last year, but at the same time is patchy. Orders are in evidence mostly at the beginning and ending of months, leaving the middle weeks somewhat bare. The cause of this patchiness or commercial dermatitis would appear to be faulty financial circulation. The textile trade in the Colne Valley has benefited by the receipt by one firm of woollen piece manufacturers, from a firm in America, of an order approximating to £12,000 worth of piece goods. The satisfactory state of the fine worsted trade is still maintained. The Heavy Woollen District firms are experiencing good demands from America, the United States placing orders for the best grades of cloth of new design, while Canadian orders cover a wide range of qualities. Information available regarding the latter market and tariff revision would appear to indicate no need for apprehension; the market appears to be one of the best overseas for the goods of this district.

Scotland

February has turned out slightly disappointing, as there has been some set-back in sales. The month is, of course, a short one, but this is not enough to account for the difference.

Business in the dyeing and finishing trades in the Glasgow and Paisley districts has been fairly good, as well as in the Vale of Leven and at Barrhead, while at Lennoxtown and Thornliebank it has been fairly satisfactory. The carpet trade is in a fairly good position, although it has been better.

Woollen yarn spinners are busy, principally on the 1928-29 winter season's goods. Increased prices are foreshadowed for these as a result of the present higher prices for wool. Wool dyers are still fairly busy, but there is very little activity in the yarn and piece dyeing sections. Dyestuff sales have been only moderate, but with some evidence of increasing business in the artificial silk lines, particularly acetyl silk.

The proposals of the Joint Dyers' Executive Committee with regard to the general establishment of piece rate dyeing have not been accepted by the Allied Association of Bleachers, Dyers, Printers and Finishers, the position in this dispute remaining the same.

Solric D'Fysun Fabrics, Ltd., are extending their works, having taken over Troqueer works at Dumfries, previously used in the tweed trade. This may perhaps be regarded as another indication of the increasing importance of the highest classes of fast dyed goods.

French Duties on Swiss Vat Dyestuffs

THE Franco-Swiss Commercial Agreement provided that certain vat dyes (Tariff No. 294) specified in a Note to the Agreement were to be dutiable at the rate of 20 francs per kilogramme. The Board of Trade have now received the text of the Note, from which it appears that the dyes in question are as follows:—

ANTHRAQUINONE DERIVATIVES.—Solanthrene Blue NRS, Solanthrene Blue NJ, Solanthrene Blue NJI, Solanthrene Blue N3IF, Solanthrene Blue NB, Solanthrene Blue N5J, Solanthrene Brilliant Blue NR, Solanthrene Yellow NJ, Solanthrene Violet NR, Solanthrene Brilliant Violet NR, Solanthrene Brilliant Violet N2R, Solanthrene Brilliant Violet N2B, Solanthrene Dark Blue NBO, Solanthrene Black N2B, Solanthrene Golden Orange NJ, Solanthrene Golden Orange N2R, Solanthrene Golden Orange N4R, Solanthrene Red NR, Solanthrene Red N5J, Solanthrene Pink N, Solanthrene Brown NR, Solanthrene Grey NB, Solanthrene Olive NR, Solane Yellow N3J.

THEO-INDIGOS AND THEIR DERIVATIVES.—Solanthrene Grey N6B, Solane Violet NB, Solane Violet NR, Solane Bordeaux NB, Solanthrene Red N3B, Solanthrene Scarlet NJ extra, Solanthrene Pink NF extra, Solane Orange NR, Solane Scarlet NB.

CHLORINATED, BROMINATED AND IODINATED DERIVATIVES OF INDIGO.—Indigo N4B. All other anthraquinone derivatives, all other theo-indigos and their derivatives, and all other chlorinated, brominated and iodinated indigo derivatives are, when the Agreement comes into force, to pay a duty of 12 francs per kilogramme.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

Future of Dyestuffs Act

MR. T. SHAW, M.P., in drawing attention to the condition of the Lancashire cotton industry in the House of Commons, induced the President of the Board of Trade to give a definite assurance as to the future of the Dyestuffs Act. Mr. Shaw's statement was that Lancashire employers asked for the abolition of the Act on the ground that it had affected the cotton trade adversely in foreign competition, and he suggested that the Government might review its policy with regard to dyestuffs. The other point he mentioned, namely, the conclusion of an agreement between the British Dyestuffs Corporation and German dyestuffs interests, seemed a little out of date, for the Corporation is now merged in Imperial Chemical Industries, and the purchase by the Corporation of the Government shares was merely part of a general scheme of capital reorganisation. Sir Philip Cunliffe-Lister was quite specific in his reply: "With regard to the Dyestuffs Act," he said, "the Labour Government did not attempt to repeal it when they were in office, and we do not propose to repeal it now that we are in office."

Dyestuffs Licences for March

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during March, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—The total number of applications received during the month was 686, of which 561 were from merchants or importers. To these should be added 11 cases outstanding on February 29, making a total for the month of 697. These were dealt with as follows: Granted, 654 (of which 636 were dealt with within 7 days of receipt); referred to British makers of similar products, 31 (of which 22 were dealt with within 7 days of receipt); referred to reparation supplies, 1; outstanding on March 31, 11. Of the total of 697 applications received, 659 or 95 per cent. were dealt with within 7 days of receipt.

A New Printing Method

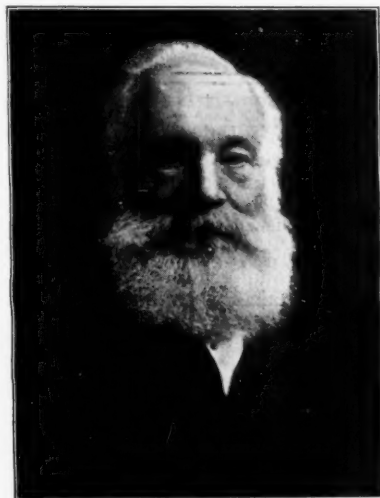
MANY of the usual condensation products used as mordants for basic dyestuffs, of phenols and aromatic amines and their derivatives, have the disadvantage of very quickly forming a lake with the basic dyestuffs. It is therefore only possible to make use of them in two baths, which is naturally costly and complicated. In the German Patent 446,485, Dr. Sazanoff, Russia, has found that such lake formation does not take place, or only after a very long time, if the basic dyestuffs are previously converted into the form of their free bases. It does not matter, in this connection, whether the free bases have themselves sufficient solubility, or whether their solubility has to be assisted by the addition of thickening, or whether their precipitation is thereby hindered.

The dyestuffs are converted into their bases by the addition of measured quantities of caustic soda, and any excess of caustic does not matter. Additions of hydrosulphite and soap are often favourable. The dyestuffs are fixed

after printing by an acid passage, for instance with acetic acid-bichromate. The process is suitable for direct printing with basic dyestuffs on white or naphtholised goods, also for the production of aniline black reserve articles and for Rongalite coloured discharges. These agents are then mixed with the printing colour.

The Perkin Medal

The Perkin Medal, which has just been presented to Dr. R. E. Schmidt, of Elberfeld, for his work on anthraquinone and allied bodies that led to the development of fast dyestuffs production, was instituted by the Society of Dyers and Colourists in commemoration of Sir William Perkin, who died in 1907 during his presidency of the Society. It is awarded at intervals of two or three years for discoveries of special importance in the science of colour. Previous recipients of the medal have been Professors Graebe and Liebermann, for their synthesis



THE LATE SIR W. H. PERKIN.

of alizarin (1908); Professor Adolf von Baeyer, for his synthesis of indigo (1911); Comte Hilaire de Chardonnet, for his pioneer work on artificial silk (1914); Professor A. G. Green, for his discovery of Primuline (1917); M. R. Vidal, for his work on Sulphur Black (1919); Mr. H. Lowe, for his work on the production of permanent lustre on cotton (1921); Mr. C. F. Cross, for his discovery of viscose (1923); and M. M. Prud'homme, for his work on Aniline Black and Alizarin Blue (1925). The medal, which is struck in gold, was modelled by the late F. W. Pomeroy, R.A., and is an excellent presentation of Perkin's head in profile.

Other medals for research in this field are the Company of Dyers' Research Medal, awarded annually for the best paper published in the *Journal*, and the Medal of the

Society of Dyers and Colourists, awarded occasionally for work of exceptional merit carried out under the Society's Research Scheme.

U.S.A. Dyestuff Imports Increasing

FROM the beginning of the present year the tonnage of dyestuff imports into the United States has shown a marked increase, with the result that the total imports of synthetic dyes for the first month of this year aggregated 415,156 lb., valued at \$327,148, as compared with 196,620 lb. of a value of \$186,387 for the first month of 1927. February, although a short month, produced a still higher import total, with an aggregate of 478,407 lb., valued at \$391,351. February, 1927, also showed an increase with a total of 312,277 lb., and an invoice value of \$262,364. This would make the totals for the first two months of 1928 and 1927 as follows: 1927, 508,987 lb., value \$448,751; 1928, 893,563 lb., value \$718,499. The percentage of dyestuffs by country of shipment imported by the United States is shown in the following table:

	Feb. 1928.	Feb. 1927.	Jan.-Feb. 1928.	Jan.-Feb. 1927.
Germany ..	56.0	49.5	61.75	43.25
Switzerland ..	32.5	33.9	26.75	33.95
France ..	1.5	1.3	1.50	4.15
England ..	1.5	4.6	1.25	5.80
Belgium ..	3.0	4.9	3.50	7.95
Canada ..	2.5	5.3	2.75	3.15
Italy ..	2.5	0.3	2.00	1.65
Netherlands ..	0.5	0.2	0.50	0.10

The increased trade, it will be observed, has been obtained almost entirely by Germany, already by far the largest exporting country.

An Important Dyestuffs Publication

THE fifth edition of *Allen's Commercial Organic Analysis*, edited by S. S. Sadtler, E. C. Lathrop, and C. Ainsworth Mitchell, is now well under way, Volume VI having just appeared (London: J. and A. Churchill, pp. 658, 3os.). The volume under discussion will make a special appeal to those concerned with dyestuffs, since it is devoted to colorimetry, dyes and colouring matters, the synthetic dyestuffs, and the analysis of colouring matters. This volume has been not only rewritten but also entirely changed in arrangement and composition from the form of the sections in the preceding edition on "Dyestuffs," which appeared largely in Volume V of the fourth edition.

DR. W. A. GALLUP writes the chapter on "Colorimetry" (pp. 18). Then follow two long chapters which make up the greater part of the volume, namely, "Dyes and Colouring Matters" (pp. 393), by Dr. E. H. Fierz-David, of Zurich; and "The Synthetic Dyestuffs" (pp. 200), by Dr. W. A. Joyce. These two articles, which are monographs in themselves from two different standpoints, practically cover the field of identification of the dyestuffs by direct testing as the chemical entity, and by testing the substances obtained by splitting up the dye colour. In both chapters the question of classification and arrangement is of great importance, and the method adopted in the "Colour Index" has been adopted by both authors. Finally, there is a chapter by Drs. H. E. Fierz-David and V. E. Yarsley, on "The Analysis of Colouring Matters" (pp. 19). In the latter chapter, the authors, discussing the literature of the subject, make one rather pungent comment (p. 613): "The standard work on this subject, to which reference is continually made, is *The Analysis of Dyestuffs*, by Arthur G. Green (Griffin, London, 1920). Most of the other books dealing with the analysis of dyestuffs, both from the English and foreign Press, are merely reproduc-

tions of this work, either with or without the consent of the author."

This volume of "Allen" will doubtless prove quite indispensable to those engaged, from various points of view, in the investigation of dyestuffs and colouring matters. It is rounded off by an index covering twenty-four pages.

An American Opinion

MR. HOMER S. FOX, the United States Trade Commissioner in London, in commenting on the British dyestuffs position, points out that the great bulk of our imported dyes come from Germany and Switzerland, these two countries supplying 98 per cent. of the total quantity of dyestuffs for which import licences were granted in 1926.

In reference to the productive capacity of the British dyestuffs industry he points out that the present capacity is much greater than home requirements plus exports at the present rate, and while satisfactory growth is reported in the home demand for British dyes, the dye export trade does not show the same favourable position. During the last two years British exports of coal tar dyestuffs have been at only 75 per cent. of the rate in 1924 and 1925, while imports have tended to increase, from the standpoint of value, although the quantity increase in 1927 over 1926 was slight, and the total quantity imported last year was only a little more than half the corresponding receipts in 1924. Progressive reductions in the import price factor are anticipated, nevertheless, during the three years which the Dyestuffs (Import Regulation) Act has yet to run, the hope being expressed that at the expiration of this period the British industry may be in a position to meet competition without further artificial assistance.

British Dyestuff Exports

DISCUSSING the export position, Mr. Fox points out that British dyestuff exports in 1927 were at practically the same rate as in 1926, exports in each of the last two years being at about 75 per cent. of the rate in the two preceding years. Exports in 1927 showed an increase in value of about 5 per cent., possibly, as in the case of imports, reflecting a higher average quality. While detailed figures for 1927 are not available, he estimates on the basis of figures for preceding years that approximately half of the finished British dye exports by value go to Empire countries (48 per cent. in 1926, constituting about 34 per cent. by weight), chiefly to Australia, India, the Irish Free State, and Canada. Australia has, during 1927, brought her dye import regulations more in line with the procedure of Great Britain by providing for the prohibition of dye imports, except under licence, of dyes of other than British origin. Among foreign countries France, Belgium, the Netherlands, China, and the United States are some of the principal buyers of British dyes.

Japan Subsidises Seven New Dyes

IN accordance with an imperial Japanese ordinance seven new kinds of dyes have been added to the list of those entitled to receive assistance under the law enacted in 1925 to encourage the Japanese dye manufacturing industry. The complete list of dyes now entitled to subsidy is as follows: Victoria Blue, Magenta, Rhodamine, Auramine, Direct Fast Black, Direct Black BH, Direct Copper Blue, Direct Blue 6 B, Direct Fast Scarlet, Direct Violet, Acid Fast Black, Acid Fast Blue, Quinoline Yellow, Wool Green S, Acid Violet, Chrome Black F, Carbazol Vat Blue, Anthraquinone Vat Blue, Betahydroxynaphthoic Acid-Anilide, Rhodamine 6 G, Crystal Violet, Direct Claret, Direct Brown M, Stilbene Yellow, Carbonil Orange, Ponceau 3 X.

Vat Colours : Penetration and Other Problems

By G. O. Mitchell

In a recent address to the Nottingham Branch of the Society of Dyers and Colourists, Mr. G. O. Mitchell (of the British Dyestuffs Corporation staff) dealt with the subject of "Vat Colours" and some of the problems attending their use. The main points are summarised below.

THE question of penetration of vat colours is one that is always with us on all forms of cotton and linen materials. True, this question of penetration is one that varies to some degree with the colours themselves. Very often some slight modification of the normal dyeing process is of some help in obtaining better results.

As is well known, many of the vat colours are normally applied at a low temperature in order to obtain the maximum yield in depth. Dyeing cold or at a low temperature is naturally all against good penetration, and it has been found that by applying this type of colour at a higher temperature, round about 120° to 130° F., on linen which is normally bad to penetrate, much better penetration results. The cold dyeing colours often possess leuco bodies of very good solubility, and this, coupled with the fact of the high dyeing temperature acting as a retarding agency, appears to have some bearing on the results.

Mechanical means are also adopted in order to attempt to bring about the desired result. Examples of this are found in certain jigs and pads which are provided with a slotted pipe through which the liquor is sucked and over which the cloth passes during its run in the machine.

It would seem that the penetration question is largely bound up with the individual characteristics of the colours themselves, even when all other methods of application or types of machine are considered.

Dyeing Undesulphidised Viscose

There are one or two points in connection with undesulphidised viscose which have come up recently and may prove of interest. In some cases it is desired to dye undesulphidised viscose with vat colours and retain the dull appearance of this type of artificial silk. As far as any small amount of work that the writer has done on this point is concerned, he has not yet found any modification of the normal vat bath which fulfils the conditions. That is to say, in the presence of alkalis and hydrosulphite, the fibre is desulphidised, and often the bath is precipitated by loss of reducing agent.

Fast colours which give a very good result on this work, however, are the Soledon colours of Scottish Dyes, Ltd., and in the three brands, Soledon Jade Green, Soledon Brilliant Purple 2R, and Soledon Yellow G, is the basis of mixed shades which are required. In addition to self dyeings.

There is also a certain demand for bleaching colours of the vat series to be dyed on viscose used subsequently for lacings on hanks of yarn which have to be desulphidised previous to bleaching.

Two desulphidising methods are used, one with a 1 per cent. solution of sodium sulphite and the other with a 1 per cent. solution of sodium sulphide.

The behaviour of the various vat colours that are fast to chlorine to these two treatments varies. The essential feature is that there must be no staining of the white by the dyed lacings, the sulphide treatment being the most severe, and the following appear to answer this requirement under the two processes :—

SULPHITE PROCESS.

All Duranthrene and Caledon brands fast to chlorine.

SULPHIDE PROCESS.

Duran. Red 5G.
Caledon Red FF.
Caledon Blue GC. RR.
Duran. Blue CC.
Duran. Black 2B.
Duran. Brilliant Violet R.
Duran. Violet 2R.
Caledon Jade Green.
Caledon Navy Blue.
Caledon Yellow 5G.
Caledon Yellow 3G.
Duran. G. Orange Y.

The dyeing of union yarn with vat colours is occasionally

demand, it being very often necessary that the shade should be fast to chlorine.

Vat Colours in Ammonia Vat

In this connection the use of vat colours which can be applied in an ammonia vat is of interest. I refer in this matter to the use of anthraquinone vat colours which are necessarily reduced with caustic soda in the first place, but applied to the fibre in a dyebath made up with ammonia and hydrosulphite.

From those Duranthrene and Caledon colours which are used, the blues are unfortunately absent, but Durindone Blue 4 BC, which is an indigoid colour, appears to work satisfactorily.

After the preliminary reduction with caustic soda and hydrosulphite, the stock vat is added to the dyebath made up as follows :—

For 50 lb. yarn—200 gallons liquor 110° F., 1 gallon ammonia '880, 2-3 lb. hydrosulphite pdr., 2 lb. glue, 20-40 lb. Glaubers salt crystals.

After air oxidation and washing, the yarn can be passed through a light soap bath at 40-50° C. as a final treatment. The following colours dye satisfactorily by this process :—

Caledon Yellow 5G, 3G.
Caledon Brown R.
Duranthrene Red BN.
Caledon Ref FF.
Duranthrene Brilliant Violet R and 2B.
Caledon Jade Green.
Durindone Blue 4BC.

Reference may also be made here to the ordinary types of vat colours which are manufactured specially for wool dyeing, notably the Anthra wool colours, Hydron wool colours or wool Vat colours, which will, no doubt, in some cases also be found of use. Some of these colours, however, are of a type which have little or no affinity for the cotton fibre, which may preclude their use on mixed yarns.

Waxed Batik Style

A style of work, with which people are not perhaps very familiar in Nottingham, is the waxed batik style. In this particular work, which is practically all exported for native wear, designs are printed on to white piece, using mixtures of waxes and resins. The waxes are printed on with hot rollers, and, when set, act as local resists to the subsequent dyeing process, which is with indigo from a zinc-lime bath. After thus dyeing, the wax is removed by running in a bath of sodium silicate, when the white design remains on the indigo grounds. The cloths are then overprinted with some striking design involving a clock face or a gramophone or something equally attractive to the native eye.

It was thought at one time that something might possibly be done in the home market as far as the wax resist design was concerned, at any rate, if vat colours could be applied to such a cloth. The difficulty to be overcome here is the avoidance of saponification of the wax and resin resist by caustic soda, which would naturally soften or remove the waxes, with loss of the required effect. After experiment it was found that if the waxed cloth was dyed with vat colours in a bath containing beta-naphthol—that is, by exactly the same process as is recommended for dyeing cotton material containing cellulose acetate silk—very satisfactory results were obtained, the design being left quite sharp, no softening of the resist taking place.

There have not been any great developments in this line, but with the present-day demand for fast colours in all classes of work the idea appears to have possibilities.

Vat Colours on Plain Cotton

The behaviour of vat colours on plain cotton containing dead cotton or neps is sometimes of interest. The brands vary considerably in this connection, not being dependent on dyeing conditions, but on the individual. The division of these things into classes is, of course, purely arbitrary, inso-

far as the difference between "good" and "very good" is concerned. Here is the list, showing covering power of vat colours on material containing neps.

VERY GOOD.

Caledon Yellow 5G Paste.
 Caledon Yellow 3G Paste.
 Duranthrene Orange 4R Paste.
 Caledon Blue RR Paste.
 Caledon Blue GC Paste.
 Duranthrene Olive GL Powder.
 Duranthrene Olive R Paste.
 Duranthrene Brown B Paste.
 Duranthrene Black 2B Paste.

GOOD.

Duranthrene Yellow G Extra Paste.
 Duranthrene Golden Orange Y Paste.
 Duranthrene Golden Orange RRT Paste.
 Duranthrene Violet 2R Paste.

Duranthrene Blue RD Extra Paste.
 Duranthrene Blue GCD Paste.
 Duranthrene Blue CC Paste.
 Duranthrene Dark Blue BM Paste.
 Caledon Jade Green Paste.

POOR.

Duranthrene Red 5G Paste.
 Duranthrene Red BN Paste.
 Caledon Red 5B Paste.
 Caledon Red FF Paste.
 Duranthrene Claret B 8720 Paste.
 Duranthrene Red Violet 2RN Paste.
 Durindone Red 3B Paste.
 Duranthrene Blue 3GT Paste.
 Durindone Blue 4BC Double Paste.
 Caledon Navy Blue Double Paste.
 Duranthrene Brilliant Violet 2B Paste.
 Duranthrene Brilliant Violet R Paste.
 Duranthrene Violet BN Extra Paste.

Colour Measurement in the Dyestuffs Industry

By T. Hedley Barry

In the following article Mr. T. Hedley Barry discusses the advances recently made in the technique of the measurement of colour in the dyestuffs industry, especially with regard to the evolution of suitable types of measuring instruments.

A UNIVERSALLY accepted standard of colour measurement is of first importance in the manufacture and application of dyestuffs, not only for the obvious reason that such a method would greatly facilitate colour matching and obviate many mistakes and disputes, but because, until some such standard is accepted, it is impossible to conduct investigations involving colour and colour changes with scientific precision.

Interest in these matters has naturally increased with the development of the dyestuff and allied industries, for their success depends ultimately upon the colour properties of their products, which must not only be of the required shade but possess the necessary degree of resistance to the various agents such as light, moisture, detergents, and so forth, which tend to cause colour changes.

Colour measurement in itself is not a simple problem, since the colour of a substance depends not only upon its intrinsic properties but upon the light in which it is viewed.

Provision of an Illuminant

The first part of the problem is, therefore, the choice of a standard illuminant. Sunlight is obviously unsuitable; not only does its quality vary, but it is not available at the convenience of the worker.

Attempts to provide an artificial illuminant which can be accepted as a satisfactory substitute for normal daylight have been numerous during the last few years. The most successful depend upon the use of a glass filter designed to cut off part of the yellow and red rays which are present in the light from an ordinary electric lamp in far greater proportion than in sunlight. Of these the Lamplough daylight lamp and the Macbeth lamp are the chief.

By normal daylight is understood a light in which the energy distribution is approximately the mean of that of light reflected from a clear north sky and that from a clouded north sky. There is, of course, the certain loss in efficiency in transmission, but for scientific work this is not a serious item, and even in general illumination it is somewhat compensated for by the increase in visual acuity in a light which is free from glare and more nearly approaches daylight.

For matching purposes, the cold north light is to be preferred, though for general illumination a rather warmer light containing a somewhat higher proportion of red rays is to be desired. Lamps of this type appear to be becoming generally accepted as providing a satisfactory illumination for scientific and technical work.

Instruments for Measuring Colour

Having settled the question of illumination, the means of measuring colours may be considered. Light consists of ethereal vibrations of varying wavelengths which on striking the retina produce the sensation of colour. The obvious method of determining colour would, therefore, seem to be to

observe its reflection or transmission spectrograph. This can be done, but for practical purposes is by no means satisfactory; quite apart from the elaborate and costly equipment, the process is a lengthy one involving numerous deter-

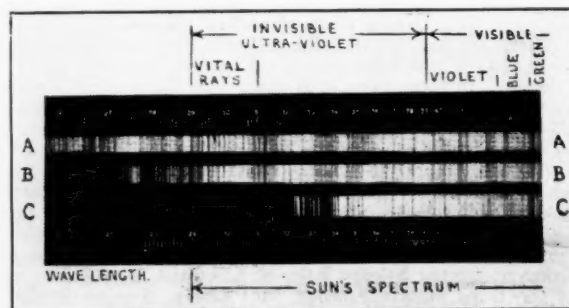


FIG. 1. SPECTRUM PHOTOGRAPH OF IRON ARC: A, WITHOUT SCREEN; B, WITH VITAGLASS SCREEN; C, WITH ORDINARY GLASS SCREEN.

minations. With a direct colour-matching instrument, the determination can be made in a few minutes, and moreover, the result is obtained in a form that is readily appreciated, and the actual colour can be readily reproduced in a similar instrument for observation and matching purposes. The question of the personal factor (of which colour-blindness may be considered an extreme case), naturally arises, but, although a difficulty undoubtedly exists, it is not in practice a serious one. With experience, the normal person soon develops a colour sensitiveness considerably greater than that of the untrained. It may generally be taken that in practice "normal colour vision" is a sufficiently well defined constant for even work of highly scientific accuracy.

Of the instruments involving the direct measurement of colour, the two which appear to be of most general application are the Lovibond Tintometer and the Guild Trichromatic Colorimeter. The former adopts as standards a series of glasses coloured red, yellow, and blue, the depth of colour being adjusted so as to give an additive series in each colour. The desired colour is matched by a combination of the standard glasses, the respective colour values of which are recorded. In order to obtain the degree of brilliance necessary to match the sample, neutral tinted glasses are used. The complete set of glasses comprises 475 units, but for many purposes only a limited range of glasses is required.

A standard set of glasses was examined spectroscopically at the Bureau of Standards, Washington, and the glasses were

found to form a regular series (K. S. Gibson and F. K. Harris, Scientific Paper 547) the formula being:—

$$T_{\lambda} - \log T = aN + b$$

where T_{λ} = Wavelength transmitted,
 N = The number of the glass
 a and b = Constants.

The Guild Colorimeter

The Guild instrument depends upon the principle of blending lights of standard colour so that on reflection the composite beam from a standard white surface matches the test sample in colour and brilliance. The result is expressed in the form of:—

$$\begin{aligned} \text{Colour} &= a \text{ units Red} + b \text{ units Green} + c \text{ units Blue} \\ \text{Brilliance} &= X \text{ per cent. of standard.} \end{aligned}$$

The source of light is a standard lamp running under specified conditions, and the filters providing the coloured light are gelatine films tinted so as to transmit lights of definite ranges of wave-length. The instrument was designed at the National Physical Laboratory, and each model is standardised there. Though necessarily elaborate and costly, it is simple to use and undoubtedly represents a very high degree of standardisation on strictly scientific principles.

Various other instruments have been designed, and there is evidently need for more than one type of instrument in view of the great variety of uses to which colour measurement is already put in modern industry.

The use of colour-measuring instruments in the dyestuff industry has certainly given a great stimulus to research. Whilst colour change could only be described vaguely as "faded," "darkened," "slightly redder," etc., there was little encouragement for systematic technical research, since the inability accurately to define the changes which formed the basis of the investigation made it impossible to make any definite progress apart from empirical knowledge. During the post-war period, however, the various research associations in this country as well as those in Germany and America have carried out an enormous amount of work, which has emphasised the need not only for colour measurement standards but for a standard method of carrying out exposure tests.

Factors in Fading

Sunlight alone does not appear to be so important a factor in fading as is generally supposed. The effect of humidity may often more than counterbalance the increase in permanence due to the reduction in actinic value of sunlight; thus tests carried out by the Woollen and Worsted Research Association show that in many cases colours fade less rapidly in the tropics than in England (Barker and Hirst, *J. Soc. Dyers and Colourists*, 1927, 43, 254). As a consequence, the problem of devising a standard exposure test is further complicated.

The objections to sunlight as a standard illuminant apply equally to its use in fading tests, and there is the further objection that even under the most advantageous conditions its action is too slow.

The use of the quartz-mercury vapour lamp naturally suggests itself on account of the high proportion of actinic rays, but, it is open to the serious objection that although it undoubtedly produces rapid fading in many cases it does not accurately reproduce the effect of sunlight in every case (Reeve, *J. Phys. Chem.*, 1925, 29, 39).

There is also the possibility of action by ozone which may be formed unless special precautions are taken to protect the specimen. The most successful results appear to be obtained by the use of carbon arcs with electrodes impregnated with various salts. The Fad-o-Meter designed by the Atlas Electric Devices Co. is based on this principle, the violet carbon arc being surrounded with a cylindrical metal casing round which the specimens are arranged.

The Fugitometer

Recently this instrument has been further elaborated and improved by Barker and his colleagues, so that the specimens are exposed in containers with Vitaglass covers, and thus are protected from external influences and connected to a humidifier so that temperature and humidity can be controlled. The instrument is termed the Fugitometer (Fig. 2). The choice of a protective glass is an important matter, for ordinary glass transmits little light of a wavelength below 3,400 A. U.,

and only about 33 per cent. of the total is transmitted, whereas the active rays of normal sunlight extend from 7,000 to 2,900 A.U. Vitaglass, made by Chance and Hunt, transmits 95 per cent. of the light between 7,000 and 3,250 A.U., and at

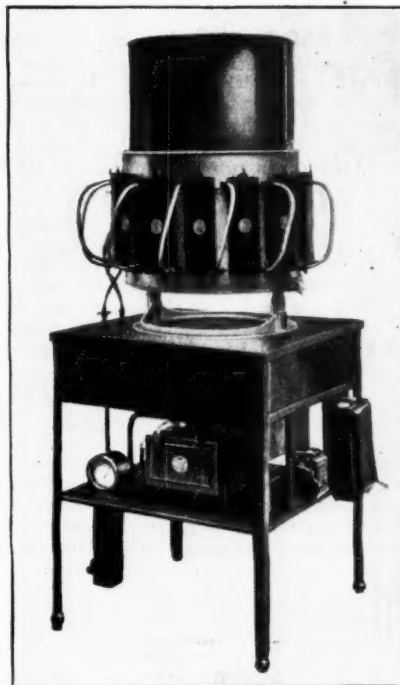


FIG. 2. THE K.B.B. FUGITOMETER.

2,900 A.U. the transmission is about 72.5 per cent. (Moss and Knapp, *J. Soc. Dyers and Colourists*, 1927, 43, 297, and *J. Soc. Chem. Ind.*, 1925, 44, 453). The transmission spectra illustrated in Fig. 1 show the greatly superior efficiency of Vitaglass, and, as a matter of fact, this has been improved upon in more recent practice.

From this rapid survey of recent work it will be seen that very material progress has been made in the scientific study of colour, and the application of the results to the investigation of technical problems. That further advances will be made is, of course, certain, but they will largely depend upon the experience obtained in the use of the methods at present available. Given a reasonably accurate and generally accepted standard of reference, progress will be greatly accelerated by the experience gained in routine colour measurement in the testing laboratories of the country. Nor is it unreasonable to expect that a more precise knowledge of colour change and composition will indicate valuable lines of investigation and provide useful clues to the fundamental causes for many of those minor disasters which are the cause of much anxiety and worry to the technical staff of a dye-works. For example, a precise knowledge of the effect upon colour and brilliance of a lake or dyed fabric caused by variation in the temperature and concentration of the reagents would be of great value in control of operations and securing uniformity of output. Further, in dealing with dyestuffs, the permanence is considerably affected by the nature of the fabric. The effect of moisture has already been referred to, and quite apart from the humidity of the atmosphere, water may occur either absorbed in the fabric or as a result of the decomposition of the fabric under the action of light.

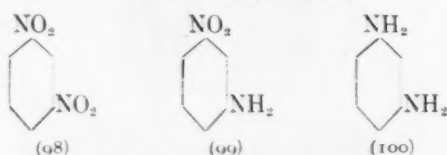
Study of Dye-Blending

In practice dyes are seldom used singly, and although an enormous amount of practical knowledge as to the effect of blending dyes for various purposes is available in the industry, the systematic study of the subject by accurate colorimetric methods will undoubtedly prove of value, especially as it would then be possible to correlate the results obtained by independent bodies of workers.

Basic Intermediates for Dyestuffs: No. XVII.—The Derivatives of Ortho and Meta Dinitrobenzene

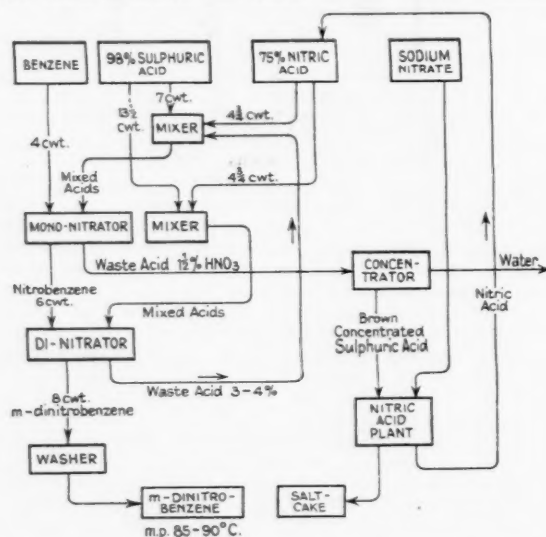
By "Consultant"

THE nitranilines and phenylene diamines are admittedly one of the more important series of dyestuffs intermediates, and although in a previous contribution to this series the derivatives of paranitraniline were described, the preparation of the ortho and meta isomers is worthy of attention. There is, of course, only one method available for the preparation of *m*-dinitrobenzene, viz., the direct nitration of benzene itself, through nitrobenzene to the dinitro compound (98).



Hollemann and de Bruyn (*Rec. Trav. Chim.*, 1900, 19, 79) showed that the direct nitration of benzene led to a 93.5 per cent. yield of the metadinitro compound, together with 6.4 per cent. of the orthodinitro compound and a mere trace (0.1 per cent.) of the para variety.

In practice, the nitration to dinitrobenzene is carried out in two stages, owing to the fact that stronger acid is necessary for the second part of the operation. Reference to the flow sheet below indicates the course of the various materials



FLOW-SHEET OF PRODUCTION OF *m*-DINITROBENZENE.

through the plant. Benzene (4 cwt.) is nitrated by the usual mixture of nitric and sulphuric acids in the same way as, and with a plant similar to, that for the nitration of xylenes described in No. XVI of this series. The temperature need not be kept quite so low, so that the operation is accelerated somewhat. Part of the acid used for this stage is obtained as a residue in the second stage, and the progress of the actual nitration is followed by the use of the nitrometer. When the acid contains about 1 to 1½ per cent. of nitric acid (i.e., 6 to 9 c.c. of gas from 1 gm. sample) the action is judged to be complete. The waste acid, which is of a dark brown colour, is run off to a concentrating plant, but the concentrated acid from this plant is too dark in colour for many purposes, and is converted into nitric acid in the usual way by heating with sodium nitrate. The crude nitrobenzene is run straight to the dinitration plant, where by the use of further acid the second nitro group is introduced. The waste acid from dinitration is used up in mononitration; it usually contains about 3 to 4 per cent. of nitric acid. The crude dinitrobenzene is run

out into tubs of water, well stirred and washed with a little sodium carbonate solution to remove acid. It may then be filtered off in presses with wooden facings, and dried. It is not only necessary to observe considerable precautions in the handling of *m*-dinitrobenzene, on account of its poisonous nature, but it is in many cases necessary to purify the dinitro compound before proceeding to the manufacture of its derivatives. The purification is best effected by vacuum distillation, with or without a current of steam.

m-Nitraniline

Although the nitration of benzylidene aniline and acetanilide lead almost exclusively to the production of ortho- and para-derivatives, it has been proposed to manufacture metanitriline (99) by direct nitration. A patent by Levinstein (G.P. 30,889) indicates the production of *m*-nitraniline by the gradual addition of aniline nitrate to strong sulphuric acid, vigorous stirring being applied and the temperature being kept below 5° C. The product contains:

	M.P.	B.P.	Acetyl derivative. M.P.
<i>m</i> -Nitraniline, 50 per cent.	114° C.	285° C.	142° C.
<i>p</i> -Nitraniline, 30 per cent.	147° C.	—	207° C.
<i>o</i> -Nitraniline, 10 per cent.	71.5° C.	—	92° C.

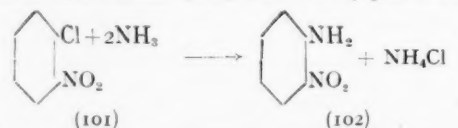
but the difficulty lies in the separation of the isomers. In actual practice to-day, *m*-nitraniline is always obtained by the partial reduction of *m*-dinitrobenzene, usually by means of sodium sulphide solution, a method which we owe to Cobenzl.

The *m*-dinitrobenzene (1 cwt.) is rapidly agitated with boiling water (400 gallons) until an emulsion has been obtained. To this emulsion is added a solution prepared in the following way:—Sulphur (48 lb.) is agitated with a solution of sodium sulphide crystals (one and a half cwt.) in water (60 galls.) until the sulphur is dissolved. The slow addition of this solution to the emulsion of dinitrobenzene and water is sufficient to keep the whole in a state of gentle ebullition, but after the addition has been completed the batch is boiled for about three hours—until a test sample yields no crystalline matter with dilute hydrochloric acid. The whole is now filtered hot into crystallising tubs, and after cooling, the crystals of *m*-nitraniline are removed, washed with water to remove acid, centrifuged, dried and ground.

o-Dinitrobenzene and *o*-Nitraniline

The only method by which *o*-dinitrobenzene can be obtained in quantity is as a by-product from the manufacture of the isomeric meta compound.

o-Nitraniline (102) is not, of course, made by the reduction of *o*-dinitrobenzene, but either by the action of ammonia on orthochloro nitrobenzene (101), or as a by-product in the



manufacture of the para derivative. In the latter case, it is separated from the crude nitroacetanilide in the following way:—The cakes of crude aceto compound are boiled with 1 per cent. sodium carbonate solution in the proportion of 125 gallons of the carbonate solution to each hundredweight of the crude material. The acetyl-*o*-nitraniline is hydrolysed to the amine, but the acetyl-*p*-nitraniline is unaffected and may be filtered off.

o-Nitraniline may be prepared from *o*-chloronitrobenzene (16 lb.) and aqueous ammonia (S.G. 880–32 lb.), the mixture being heated to 170° to 175° C. in an autoclave for four hours. The pressure developed is considerable—of the order of 50 atmospheres—but drops to 30 atmospheres during the course of the reaction. After cooling, the *o*-nitraniline may be recrystallised from boiling water (65 galls.). About 9 lb. to 10 lb. is obtained, m.p. 71° to 73° C.

Dyes and Their Application : Recent Technical Progress

By L. J. Hooley

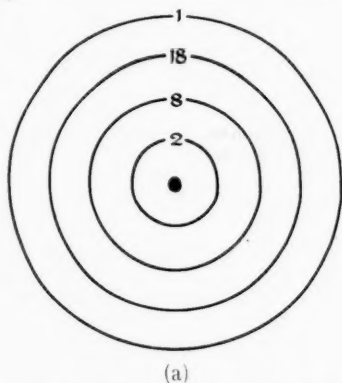
The Cause of Colour

LAST month some illustrations were given of the way in which modern views of the manner in which atoms combine, which have been derived mainly from the study of inorganic compounds, have been able to provide explanations of the structure of mordant dyes. These views, coupled with the theory of the structure of the atom developed in the first instance by Rutherford and Bohr, are also of great interest in connection with colour in general.

In a review of some colour theories in the DYESTUFFS SUPPLEMENT of May, 1927, it was pointed out that historically the cause of colour had been variously given as due to vibration in the molecule as a whole, to vibrations of selected atoms, and to vibrations of electrons. The present tendency is to assign greatest importance to the electron, as recent knowledge of the dynamics of the atom has indicated that the electron is most likely to show the type of vibration which will account for the absorption of visible light. This method of approach offers more immediate prospect of reconciling colour in organic and inorganic compounds than does, for example, the quinone theory, which as such does not explain the blue colour of copper sulphate, or why cupric salts are generally blue or green and cuprous ones colourless.

Colour of Copper Compounds

Copper affords a convenient example. Its atom, with an atomic weight of 63, is believed to have 63 electrons, so that on a *a priori* grounds an explanation in terms of electrons might be very complicated. Actually only one of these 63 electrons is considered to be directly effective in colour production. Taking the 63 negative electrons with the small central nucleus of equivalent positive electricity, 34 electrons are embedded in the nucleus, while the remaining 29 (this being the atomic number of copper) rotate in essentially elliptical orbits round the nucleus as focus, under the attraction of its positive charge.



(a)

For the present purpose it is simpler, however, although inaccurate, to take the earlier view and assume that the electrons rotate in circles round the nucleus as centre.

These 29 rotating electrons are divisible into groups, 2 electrons rotating in a circle of radius 1, 8 in one of radius 2, 18 in one with radius 3, and one in a circle of radius 4. On the quantum theory, these with radius 1 have 1 unit or "quantum" of energy, those with radius 2, 2 quanta, and similarly for the others. An electron can only change its orbit by jumping into another one (usually an adjacent one): it cannot take up an intermediate position with a radius of $1\frac{1}{2}$ or $2\frac{1}{2}$. If it falls from the second orbit into the first it must give up its second quantum, which it does as radiant energy. Similarly on jumping to an outer orbit a quantum of energy must be absorbed from outside. However, under ordinary chemical influences the groups of 2, 8, and 18 are extremely stable, and practically no changes take place. It is the outermost electron which accounts for most of the chemical properties of copper and which gives monovalent cuprous compounds. For a reason, however, which is not clear, the group of 18 can lose one, which joins the lone one in the outermost

group. When this happens copper becomes divalent and the compounds which it then forms, the cupric ones, are blue.

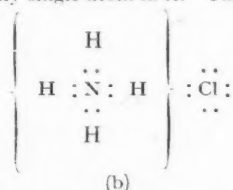
The idea that it is this change which causes the colour is not surmise. The numerical value of a quantum of energy for any electron can be very easily calculated. The frequency of visible light is known, and hence the approximate energy change which will absorb it can be calculated, and this affords a numerical basis for the view that the blue colour of the cupric salts is due to the transference of an electron from the third to the fourth group. All the other electrons are too tightly held, and their frequencies consequently too high, for their absorption effects to be apparent to the eye.

Zinc has the same structure as copper, but contains two electrons in the outermost group and is divalent. With this element, it does not appear possible for another electron to come out of the 18 group; but if it were, zinc would be expected to become trivalent and coloured.

Similar conditions to those of copper are assumed to account for the colour of the other elements including the transition elements and those of the rare earths, although the electron movements responsible are different in different elements.

Organic Compounds

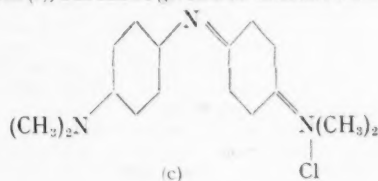
The consideration of compounds is, of course, more complicated than that of atoms. Nitrogen contains five valency electrons in its outer ring and hydrogen one; nitrogen can combine with four atoms of hydrogen, the link joining each atom consisting of two electrons, one from the nitrogen and one from the hydrogen. For some reason it cannot take more than four atoms in this way, thus leaving one nitrogen electron unengaged. This disengaged electron can join up with, for example, a chlorine atom which already has seven valency electrons, to make a stable group of 8 or "octet." Removing one of the electrons from the nitrogen, however, leaves it positively charged, as there are not now sufficient to balance the positive charge of the nucleus. Similarly the chlorine atom becomes negatively charged. The NH_4 and Cl groups are considered to be held together only through the attraction of these opposite charges and not through the direct sharing of electrons as in the case of nitrogen and hydrogen. The chlorine must be regarded as attracted to the NH_4 group as a whole and not to any single atom in it. The linkages between



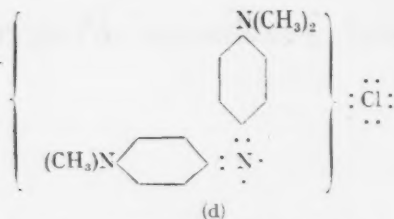
(b)

N and H are described as covalent, being identical with co-ordinate linkages except in their manner of formation, and are the real chemical linkages. The difference between this type and ionic linkage is seen in the absence of salt properties, in low volatility and high stability. The four hydrogens can be replaced by other groups such as alkyl or aryl, the four groups being known as co-ordinate ones.

Dilthey (*J. prakt. Ch.* (2), 109, 273) has explained colour formation in organic compounds in terms of these co-ordinate groups: he considers the colour to be due in the first instance to one or more of the co-ordinate positions being empty, and in the second to an ionic group which greatly enhances the colour. The theory was developed first in the triphenylmethane series, but an example may be taken among the nitrogen dyestuffs, e.g., Bindschedler's Green. This is usually formulated as a quinone as in (c), but can be given a co-ordinate formula as in (d).



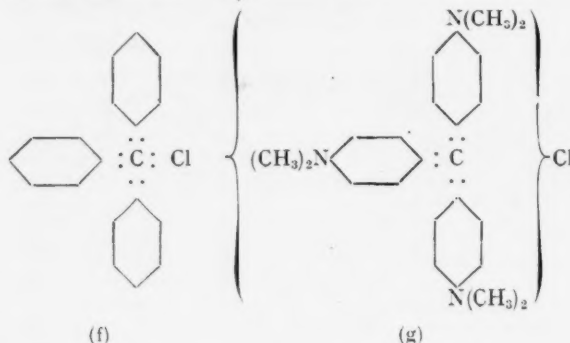
(c)



In the case of the triphenylmethane series it is the central carbon which is of importance. Carbon, like nitrogen, can attach four co-ordinate groups, but unlike nitrogen it satisfies its four valency electrons in the process, so that it does not need to unite with chlorine like nitrogen. Chlor-triphenyl-methyl is shown as a co-ordinate compound in (f). Dilthey claims that, in the triphenylmethane dyes, the chlorine leaves the co-ordinate group and becomes ionic, leaving a blank co-ordinate position as in (g), which is responsible for the colour.

A possible way of testing this theory is to find whether, on filling the empty co-ordinate positions, the colour disappears. Using piperidine for this purpose, Dilthey and Wizinger

(Ber., 59, 1856) find that malachite green, auramine, phenolphthalein, and several quinones lose their colour. Pyridine may be substituted for piperidine, but is not always so effective.



With the azines, oxazines and thiazines the action is less marked.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

The better time in the dyestuffs market which has characterised 1928 still holds, and the general belief is that the improvement will become more rapid as the year passes. It is to be hoped that any doubters of the skill and vitality of the British textile trade visited the Artificial Silk Exhibition and saw the wonderful display of textiles and colour for which the leading manufacturers, dyers, and printers were responsible. The increase in exports of such materials, which has been the outstanding feature of the textile trade for some time, must appear almost tardy to a lover of beautiful things, and at the relatively low price at which they are offered it is difficult to think that they can be other than irresistible to a woman of any race.

Fast colours are still to the fore, and dyestuffs possessing the necessary fastness properties show the greatest increase in sales. Even taking into account the war period, the movement towards fastness has been slow; so slow, indeed, that it seems difficult to realise that the patents covering the use of such an apparently modern product as Naphthol AS expires within the next few months. Bearing on this move towards fastness, the presentation of the Perkin medal to Dr. R. E. Schmidt at the Dyers' and Colourists' annual dinner in March was singularly opportune.

The American yarn spinners are at last making an attempt to put their house in order which, in boldness and in vision, appears to be commensurate with the deplorable state of that vitally important section of the cotton trade. The basis of the scheme is wholesale amalgamation of the mills, and it is gratifying to note that the banks are in favour of such a scheme.

Yorkshire

DESPITE the optimism displayed by the daily press, the present year experiences a struggle to maintain a superiority over last year on turnover. Lower prices now ruling make the struggle a little more difficult. March, while being a little better than January and February respectively, was no better than March of last year. West Riding intermediate and colour manufacturers report a distinct improvement in export trade, even to the Continent, which up to recently gave us little.

Reference has been made above to the lower level of prices as compared with that of last year, and we now have a drop in the price of petrol. It is usual for the price of benzol to follow that of petrol, but no sympathetic change has yet been observed, and opinion expressed here is that none will occur until present commitments are discharged, although the spot market will doubtless soon respond to the drop in price. Xylene prices for the time being appear to have found a firmer base, and increases are reported, there being a good demand for delivery.

A further move has been made by the trade unions connected with the dyeing and finishing section to effect a settlement of the dispute, now over twelve months old, between them and the employers. The operatives' secretaries of the sectional reference boards have been instructed to send an invitation to the employers' secretaries of the boards to call a meeting to consider the terms of the letter sent by them to the employers' organisation on January 18 last. This move appears to indicate that as they have failed to obtain the consent of the employers' main body (the Allied Association of Bleachers, Dyers, Printers, and Finishers) to their proposals, they now hope to submit them to the various sections of the trade in an endeavour to secure local agreements. The dispute affects 85,000 operatives in Yorkshire, Lancashire, Cheshire, Derbyshire, and parts of Scotland.

The fine worsted trade here is not so busy as some weeks ago, and in a few places short time is in operation. The majority of mills, however, are working overtime. The home demand for medium qualities is brisk.

Scotland

Business has shown a tendency to taper off during the last fortnight or so. How far this is due to the effect of Easter is difficult to gauge. While, of course, Easter makes practically no difference as far as home business is concerned, hardly any holidays being taken in Scotland, business from outside is affected. However, whether this is the right reason or not, it is the less pessimistic one.

Throughout Scotland as a whole business in the earlier part of the month was fairly firm, especially in the Kilmarnock, Lanark, Walkersburn, and Galashiels districts. From around Glasgow reports were not quite so satisfactory, and some trades other than the textile seem to have been experiencing a bad spell for which they found it difficult to account.

Woollen weavers and spinners are still active, and knitted goods are in good demand. The rising prices of wool have not made much difference to quotations so far, but may have an effect on the prices of next season's spring samples. The carpet section are fairly well occupied. Cotton dyers and printers have only moderate business in hand, but wool dyers are better off. The chemical markets are moderately active, but the demand for dyestuffs fell off rather towards the end of the month.

The fire which took place at the Thornliebank Dyeworks of the Calico Printers' Association had rather disastrous consequences and a large portion of the works was burned out.

Messrs. J. and P. Coats are reported to be engaged in carrying out experiments in the production of artificial silk at Paisley. A section of the public seem to have made up their minds that this firm is to be associated with artificial silk manufacture in some form or other.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

Methods of Leather Dyeing

In the paper by Mr. F. T. Herndl, leather trades chemist to the Society of Chemical Industry in Basle, published in this issue, a comprehensive and practical account is given of modern methods of leather-dyeing. The author was unfortunately unable to attend the conference in London for which it was prepared, and in his absence the paper was presented by Mr. W. H. Foster of the Clayton Aniline Co. The indebtedness of the leather manufacturer to the makers of synthetic dyestuffs is shown in several instances where what were formerly difficult dyeing operations have been made simple, and the reader will note some interesting comparisons between British and Continental practice. A point of particular interest to leather dyers is the author's reference to the use of modern pigment finishes or lacquers for leather, and the conditions that should be aimed at when employing this method.

New I.C.I. Colour

THE latest addition to the B.D.C. collection of colours, announced by Imperial Chemical Industries, Ltd., is Chlorazol Fast Scarlet 8BS, which gives very bluish shades and, in combination with Chlorazol Fast Scarlet 4BS, covers a wide range of shades. It is described as combining good level dyeing properties with good fastness to alkalis, alkaline storage and acid, and although applicable to all types of cotton materials, it is of special interest for the dyeing of cotton piece goods. It gives solid shades on unions of wool and silk, while leaving both wool and silk practically unstained in the presence of cotton. Applied to cotton-acetate silk unions, the acetate silk is unstained. In addition, it is suitable for dyeing artificial silk, paper, and jute.

"The Fastest of Fast Blues"

THIS is the description by Scottish Dyes, Ltd., of their latest brand of Caledon Blue RC. Since this brand was put on the market, the sales of this colour have rapidly increased, and the dyeing trade have endorsed the makers' own very high opinion of it by increasing last year's consumption to almost exactly double that of 1926. Belonging in the first instance to what has been for the last twenty-five years admittedly the fastest series of blues, it also represents the highest fastness within this series. Its most distinctive feature is that while having excellent fastness to light, washing, and kier boiling, it has, at the same time, excellent fastness to chemics. Being a Caledon colour its resistance to perspiration, potting, cross-dyeing, street-mud, milling, acids, alkalis, rubbing, mercerisation, hot pressing, decatizing, and salt spotting can be taken for granted.

In addition to this all-round excellence in fastness, the colour is prepared in a very pure form, which means it is particularly suitable for use in any type of dyeing machine, the complete solubility of the leuco body making it very suitable for processes in which filtration takes place, as, for example, in the dyeing of cops where insoluble impurity is filtered off by the outside of the cop with consequent staining. The penetration for this purpose is complete, as can readily be seen by taking a section through a dyed cop and comparing the inside and outside portions.

The colour possesses the desired reddish shades of blue, which are missing from other types of fast blues of this series.

Of Interest to the Piece Dyer

HITHERTO the advantages which this colour offers have appealed most directly to the yarn dyer. The colour is also of great importance to the piece dyer. As it gives improved fastness to washing and bleaching, clear level reddish-blue shades of great brightness, the dyeings are less susceptible to Yellow Disease, and the dyer is in the position of being able to assure his customers of using the fastest blue available. All this is obtained at only very slight increase of cost compared with the inferior blues. The colour is, of course, most important for cotton, but it can be used equally well for linen; it comes among some of the best Caledon Colours for dyeing natural silk, and like the other vat colours, gives brilliant shades on artificial silk.

Dispute in the Dyeing Industry

THE dispute in the dyeing industry over the introduction of collective piece-work rates is assuming a serious aspect. The trade unions comprising the Joint Dyers' Executive (the National Union of Textile Workers, the Amalgamated Society of Dyers, the Bolton Amalgamation, the Radcliffe and District Dyers' Society, the Midland Counties Federated Dyers and Scourers, and the Leeds District National Union of General Workers) have sent a communication to the individual dyeing firms in their respective areas intimating that, in the event of failing to arrive at a satisfactory settlement of the dispute relating to the introduction of collective piece-work or the revision of the time-workers' schedule, their operatives will cease work on the second pay-day in June (*i.e.*, Friday, June 8). This step of communicating direct with individual firms is due to the fact that the unions have been informed that "no collective action can be taken by the Employers' Federation to enforce piece-work where firms are not willing to change from time rates to piece-work rates." In many instances it is stated—notably that of the Bradford Dyers' Association—collective piece-work is already in operation, and there is some speculation as to whether the threatened cessation of work would include all firms and affect the 80,000 operatives as a whole, or would be confined to the firms not prepared to grant piece-time rates. The Joint Dyers' Executive Committee are understood to be willing to discuss the time-workers' schedule of wages if the trade unions will consent to discuss juvenile wages and the "pegging" of jobs. The unions, however, are strongly opposed to any revision of the juvenile scale, and for the moment the industry is definitely threatened with a stoppage in June. Within the intervening month, however, efforts will no doubt be made to avert so serious a dislocation of the industry.

Dyestuffs Licences for April

THE following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during April, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—The total number of applications received during

the month was 583, of which 496 were from merchants or importers. To these should be added 11 cases outstanding on March 31, making a total for the month of 594. These were dealt with as follows:—Granted, 550 (of which 538 were dealt with within seven days of receipt); referred to British makers of similar products, 37 (of which 32 were dealt with within seven days of receipt); outstanding on April 30, 7. Of the total of 594 applications received, 570, or 96 per cent., were dealt with within seven days.

Textile Institute Spring Conference

ARRANGEMENTS are now nearly complete for the spring conference of the Textile Institute which is to be held in Cologne during Whit-week. On Saturday, May 26, the delegates will visit the new exhibition hall buildings and inspect the International Press Exhibition. On Whit Monday the Conference will be opened in the Public Hall, at Cologne, and in the evening the Institute members will meet for dinner. Papers will be presented by Professor R. Herzog, of Berlin, on "Cellulose"; by Dr. Freiburger, of Charlottenberg, on "Cotton Bleaching"; by Professor Henry Clay, of Manchester University, on "Trade Barriers and World Prices." During the conference, visits will be paid to various industrial establishments at Munchen-Gladbach, Crefeld, Viersen, and Aachen.

America's Best Dyestuffs Year

PRELIMINARY figures compiled by the United States Tariff Commission show that the domestic production of coal-tar dyes for the year 1927 exceeded the production of any previous year in the history of the American dye industry. Prior to the war, the United States was largely dependent upon foreign sources for dyes. Synthetic colours are, of course, essential there as in this country for the domestic textile and other dye-consuming industries. In 1927 dyes of domestic production supplied 94 per cent. of American consumption, and there was, in addition, an exportable surplus of the bulk low-cost colours amounting to over 26,000,000 lbs.

The 1927 production of approximately 95,000,000 lbs. was an increase of 8 per cent. over the production of 1926. The sales of dyes in 1927 were about 98,200,000 lbs., valued at \$38,200,000. The increase in sales over 1926 amounts to 13.8 per cent. by quantity, and 5.2 per cent. by value. Other outstanding features of American dye production during 1927 were: continued price recession; increase in production of vat and other fast dyes; production of many new fast and specialty dyes; reduction in the number of domestic manufacturers; decrease in dye imports; and increase in the quantity and decrease in value of exports.

A Record in Vat Dyes

THE production of vat dyes in 1927 set up a new record with a total of over 4,500,000 lbs., as compared with 4,000,000 lbs. in 1926. Before the War there was no production of vat dyes in the United States, and these were imported from Germany and Switzerland.

Many domestic textile manufacturers have, in recent years, placed on the market a variety of fast-dyed fabrics of cotton and linen marked with a trade name and bearing a statement or guarantee as to their fastness. These fabrics are frequently made up into garments, such as dresses, men's shirts, and children's clothing, similarly guaranteed. The public at large are thus coming to the realization that, although the fast dye is more expensive, the cost of dye per yard of fabric or per garment is, in general, a small fraction of the total cost, and that it is more economical in the long run to invest in the fast-dyed fabrics or garment. The increased consumption of vat dyes is proof of the demand.

Imports of Dyes into India

THE imports of dyes into India during 1927 showed a satisfactory expansion compared with the year 1926, the total values during the years being 200 lakhs and 159 lakhs respectively. The imports of alizarine rose from 4 million lb., to 5½ million lb., and of aniline dyes from 9 to 12 million lb. Though as usual the bulk of the imports came from Germany, the United Kingdom made satisfactory progress during the year, and imports of British alizarine increased from half a million lb. to 1.3 million lb., and imports of aniline dyestuffs from 349,000 lb. to 439,000 lb. The expansion in the total imports, our Indian correspondent points out, is due to the revived demand from the textile industry, while the increase in the share of the United Kingdom has been due to better marketing arrangements, which, if continued, may result in continuous progress.

Artificial Silk Handbook

The Artificial Silk Handbook (John Heywood, Ltd., pp. 142, 3s. 6d.) contains a large collection of information respecting this large and still rapidly extending industry—historical, technical, commercial and statistical. Its comparatively small compass and the condensed character of its matter make it particularly handy for reference, as stated in the preface to this edition, the third by the way. The year 1927 witnessed a very remarkable increase in the production and use of artificial silk. During the first nine months Great Britain produced more artificial silk than it did in the whole of 1926; and although at the time of writing the actual figures for 1927 are not available, they are about 38,500,000 lb., compared with 25,500,000 lb. in 1926. Both imports and exports showed great increases. This rapid expansion in the artificial silk industry is not confined to Great Britain; the United States, Germany, France, and other countries are making quite as rapid strides, in fact in some the rate of progress exceeds that of this country. Artificial silk is proving, it is stated, the salvation of several branches of textile and allied industries. It is estimated that one loom in every eight is to-day weaving artificial silk, whilst in the knitting trade most machines are working it. Apart altogether from the production of fabrics, braids, and trimmings, new uses for artificial silk are being continually found; for instance, as hair for dolls and for wigs, for bead printing, for the "bloom" of artificial flowers and fruit, and so on.

An American Estimate

THE annual review of *British Chemical Trade in 1927*, by Mr. Homer S. Fox, American Trade Commissioner in London, just published by the United States Department of Commerce, includes a chapter on the dyestuffs situation in this country in which the principal developments of the year are noted. The dyestuffs industry, Mr. Fox remarks, is one of those which have been most prominently mentioned during the past year in connection with international agreements. So far, however, no official announcement has been made regarding the entry of British dyestuffs producers into any such agreement, and while it would be idle to speculate in this direction, the prospects of the conclusion of an agreement between British and Continental producers do not, at the beginning of 1928, appear especially promising, for the immediate future at least, to judge from the somewhat indefinite statements which have recently appeared from the groups most interested. Negotiations may continue, and the agreement reported late in 1927 between French and German dye interests might serve as a nucleus around which a more comprehensive agreement could be developed. Any attempt at a forecast, however, is useless, in the absence of more complete information from the parties concerned.

Modern Methods of Leather Dyeing

By F. T. Herndl

The following paper by Mr. Herndl, leather trades chemist to the Society of Chemical Industry in Basle, deals comprehensively with modern methods of leather dyeing and indicates some of the variations between British and Continental practice. The paper, which was prepared for a recent conference in the Leathersellers' Hall, London, was presented, in the absence of the author, by Mr. W. H. Foster, of the Clayton Aniline Co.

In dealing with the subject of leather dyeing, a few words about its origin may be appropriate. As is well known, this art was practised in very early times, as proved by discoveries in Egypt and elsewhere.

The principal colour used was red, produced with kermes and alum, which later, after the discovery of America, was supplanted by the better cochineal and alum. Other colours were also produced by means of vegetable, mineral, and animal matter. For instance, Persian berries and alum, or fustic and alum, were used for yellow, indigo for blue, verdigris for green, and even the well known application of logwood and iron, as it is still practised to-day, dates back a few centuries.

Introduction of Coal Tar Dyestuffs

Through the invention of artificial dyestuffs, during the latter part of the last century, the art of leather dyeing has been completely revolutionised. Although tanners and leather dressers may be classed as one of the most conservative industrial bodies, the comparatively easy and quick method by which coal tar dyestuffs can be applied has entirely changed the manner of leather dyeing in a few decades. Owing to the keen competition of late years in the leather trade, the art of leather dyeing may now be considered a science, which is being taught practically in all leather technical institutes of the various industrial countries.

Colour Mixing, Matching, and Toning

When mixing and matching colours it must be considered that colour is not a material existence, but a sensation to the eye; therefore a general knowledge of colour physics is essential to a successful leather dyer. It is not in the province of this paper to enter into the theories of colour science. The colours that concern us most come under the heading of the so-called "impure" colours, of which the primary are red, blue, and yellow, these three resulting in black when mixed in the correct proportions. By means of these primary colours, all other existing shades may be produced by judicious combination. This practice, however, is not always applicable to leather dyeing. Especially with artificial dyestuffs, the leather dyer must carefully choose his dyes for the successful production of the desired shades. Experience has proved that a combination of primary colours does not always result in level dyeings, as some dyes may strike quicker on the leather than others, thus causing the flesh, and consequently the broken grain, to show quite a different colour from the grain of the skin. It is therefore advisable to employ dyestuffs, whenever possible, of approximately the same shade as the desired colour. It would not be expedient, for instance, to use yellow, red, and blue to obtain a tan, when a homogeneous dye could be supplied by your dye manufacturer to produce the required shade. This theory, however, does not apply to the group of a recently invented new dyestuff, to which I shall refer later.

When toning and matching colours, it must be borne in mind that it is not always advisable to use black for saddening purposes, as more often than not black dyes are mixtures and will, moreover, produce poor and hungry dyeings. Excellent results may be obtained by the employment of a complementary colour for the purpose of toning off bright shades. For example, a vivid violet can easily be saddened with a small quantity of a reddish yellow, or a blue can be darkened very effectively by the addition of a little orange, and so on. For toning down reddish browns, green should be used in preference to black or blue.

The manner in which synthetic dyestuffs are applied on leather on the Continent do not always agree with the methods employed in this country. To quote an example, acid dyes are chiefly used over here for both classes of leather, chrome and vegetable tanned, whereas in other countries they mostly employ direct dyes for chrome leather, and for vegetable tannages basic dyes are the order of the day.

Methods of Dissolving Dyestuffs

During my visits to various leather works here and abroad, I have noticed that insufficient attention is given to the dissolving of the dyestuff, yet this matter is most important to successful results. The ignorance of some dyers, usually in smaller works, regarding the proportion of dyestuff to a given quantity of water, is really appalling.

In the first place, one should never attempt to dissolve more than a $\frac{1}{4}$ lb. of dyestuff to a gallon of water. The receptacles used should be enamelled metal buckets to enable thorough and quick cleaning after use. For the chrome upper leather trade, where large quantities of skins are to be dyed at one time in the drum, the installation of a proper feeding plant is of great advantage. A suitable installation of this kind consists of a number of vats made of tinned copper or lead, or of well enamelled cast iron. The vats, marked with the corresponding number of the drum, are placed, space permitting, in a separate room just above the dyehouse. Each vat should have three pipes, supplying steam, hot and cold water. A sufficiently wide leaden tube leading to the respective drum should have a valve close to the vat to draw off the dye liquor. The capacity may vary between 100 to 150 gallons, to allow, at the same time, a control of the right quantity of water.

The dyestuffs are dissolved either in boiling water or by pouring hot water over them and boiling them with a steam coil. As a rule, basic dyes will dissolve more readily than other classes of dyes. They are, however, somewhat more sensitive to temporary hardness of water. In these cases, the dyestuff is first made into a paste with water and acetic acid, and then boiling water poured over, well stirred, and passed through a sieve to prevent solid particles of dyestuff from getting on the leather. When dissolving auramines, or compounds containing this dyestuff, hot water, not higher than 160° F., should be used.

The Dyeing of Chrome Leather

As is well known, chrome leather when tanned and thereafter shaved, contains a certain quantity of free acids and chrome salts, which must be thoroughly removed prior to dyeing. This procedure should be always carried out just before dyeing, as neutralised chrome leather becomes acid again in a comparatively short time when exposed to atmospheric influence.

To obtain a perfect deep black, Chrome Leather Black, which belongs to the direct cotton dye group, may be applied without the use of a mordant, such as logwood or hematin. If it is found necessary, however, to use some plumping agent for the leather, hematin may be added to the dyebath after complete exhaustion. The reason for this reverse method is that logwood has a tendency to favour penetration of the dyestuff. This means that a higher percentage would be necessary in producing a jet black to compensate for the loss of dyestuff caused by deeper penetration.

Chrome Leather Blacks are not compound dyestuffs, and are manufactured in various strengths, of which the highly concentrated brands will produce a deep black on heavy box calf and chrome sides with as small a quantity as 0.4 per cent. to 0.5 per cent., while the lighter skins require a slightly higher percentage of dyestuff, on account of the larger surface of leather to be dyed.

The fat liquoring is usually carried out after dyeing in the same bath if the temperature of the dye liquor has not become too low during the dyeing process.

The Dyeing of Willow Calf

For the dyeing of willow calf, only prime skins should be used, although there are some manufacturers who maintain that they turn 90 to 95 per cent. of their tanning output into colours. It stands to reason that the raw material and tannage in such an enterprise must of necessity be of first-class

quality, and the use of some sort of "dope" finishing must be resorted to also, in order to bring the goods to a standard commercial value.

For the present, let us presume that we have to dye a pack of calf skins which have already been sorted for colours and shaved down to the proper substance. The skins being of first class quality and of very good colour, doping should be avoided, and therefore the method of dyeing will differ slightly from the ordinary procedure. The goods are first thoroughly washed in the drum, preferably in running water for 15 to 25 minutes. The drum is then stopped and a lukewarm bath prepared at about double the quantity of water to the shaved weight of the skins. The drum is closed and set in motion. In the meantime 2 per cent. borax or 1.25 to 1.50 per cent. bicarbonate of soda has been dissolved, and this solution is added through the hollow axle while the drum is in motion. In this neutralising liquor the goods are kept running for half an hour and are then washed in the open drum for 10 minutes. The skins are now ready for dyeing, but it is always advisable to test them first for acidity with a piece of blue litmus paper. When pressed on the leather, the paper must retain its blue colour; if dabbed on a freshly cut edge of the leather, the paper may turn slightly red, as it would take a larger percentage of neutralising agent to remove the acid from the inner part of the leather, which would cause, however, loose grain when the skins are finished.

Method of Dyeing Chrome Leather

For dyeing chrome leather, drum dyeing is the only suitable method, because for this class of leather, the affinity to the dyestuff is considerably less than to vegetable tanned leather, and therefore the rotary movement of the drum enables the dyestuff to strike quicker and easier on to the leather fibre.

The quantity of dyestuff should never exceed 2 per cent. of the shaved weight of the leather, whereas the water necessary for the dyebath at 160-170° F. usually amounts to three times the aforementioned weight for medium and dark shades. For pale colours, a larger bath is required to obtain level dyeings.

As previously mentioned, direct dyes are chiefly employed for bottoming, but acid and some chrome fast dyestuffs may also be applied, either alone or in combination.

Before charging the drum, the goods are suitably warmed, to avoid a sudden cooling-off of the dyebath. The skins are kept running for half an hour without the addition of acid, even though acid colours may have been employed. Acid has the tendency, when used with acid or direct colours on chrome leather, to cause faulty grain to become more pronounced.

As the skins are intended to be topped with basic dyes, a slight mordanting of some vegetable tanning matter is essential. From 1 to 2 per cent. of gambier, preferably plantation gambier, is customary, which is well dissolved and added to the dyebath. The goods are then worked for a further fifteen minutes.

The liquor is then drawn off and the drum replenished with the same amount of hot water as previously used. For topping, 0.2 per cent. to 0.5 per cent. of basic dyes may be applied. After 20 to 30 minutes the dyebath is exhausted and the fat liquor is now added if the temperature should prove to be still suitable for this process, otherwise a fresh bath must be prepared.

Fat Liquoring

Regarding the question whether the fat liquoring should take place either before or after dyeing, continental willow calf manufacturers are of divers opinion. However, it appears to be customary with some of the large enterprises to fat liquor before dyeing.

For fat liquoring chrome leather, no hard and fast rule can be laid down, as to what kind of fat liquor it is best to adopt. The divers conditions existing in the various works do not allow the recommendation of any specified fat liquoring agent. However, it is customary to use sulphonated fish oils and neutral soaps for blacks, and sulphonated neatsfoot oil, neutral soap, and egg yolk for willow calf. The percentages of these ingredients vary according to the tannages and the class of leather to be dealt with.

Another very important factor in the manufacture of

coloured chrome calf is the drying after dyeing, which should always be carried out at a fairly high temperature. The skins are simply hooked up and on no account strained. When thoroughly dry, they are heaped in stacks and are allowed to mature in a cool place for seven to eight days, preparatory to further finishing.

A very significant detail is the moistening of the skins prior to staking. It should be borne in mind that the grain of the skins must not come in contact with the damp sawdust, nor sprayed with water for the aforementioned purpose. Therefore the objectionable practice of steeping the leather in water before staking is not suitable for high-class willow and box calf.

Waterproof Chrome Upper Leather

For the manufacture of leather for sports boots, which usually have to stand very hard wear, dyestuffs should be selected that will readily penetrate chrome leather. The Society of Chemical Industry in Basle has a product on the market under the name of Chrome Fast Brown PC, noted for its excellent levelling power and thorough penetration on chrome leather. Chrome Fast Brown also facilitates the penetration of other dyestuffs, acid and direct, when used in combination; therefore it finds employment in the production of all shades of brown where good penetration is required. For the dyeing of chrome garment leather, Chrome Fast Brown PC renders excellent service.

Staining, Brush Dyeing, and Spraying

Apart from the different methods of applying dyestuff to leather by immersion, a dye solution may be also applied on the surface of the leather by means of a brush or by spraying with a specially constructed spraying plant.

The staining process is mostly used for large heavy hides and kips or heavy calf skins intended for the bag and port-manteau trade. Stale hides should be first scoured and sumached, struck out and re-set, and subsequently dried at a low temperature.

Many hide manufacturers employ basic dyes for a first coating, using perhaps a small quantity of iron with the dyestuff, and apply this solution two or three times to obtain the proper depth of shade. It is preferable, however, to exclude iron in dyeing this class of leather because iron salts, no matter how weakly they are applied, always destroy leather fibre in time; consumers are waking up to this fact and insist that iron should not be used.

A better method is to bottom the leather first with a suitable acid dyestuff, and then apply the basic dyestuff for a second coat, to give the leather the necessary brightness of shade. By adopting this method, more uniform dyeings are obtained than when basic dyes alone are employed.

The Dyeing of Gloving Leather

Alum and oil dressed skins may be classed under this heading. As alum dressed leather has practically no affinity for artificial dyestuffs, it has been until recently the custom to use natural dyestuffs for this leather.

Since the introduction of Neolan colours and other similar synthetic dyestuffs, it has become possible to dye alum dressed skins solely by the aid of these dyes. However, as the present demand is for washable kid-leather, a preliminary re-tanning with some chrome tanning salt is essential. The goods are first suitably wetted back in the drum to remove the surplus starch, otherwise the subsequent dyeings will be very irregular. The skins are then re-tanned with the chrome salt and dyed in a fresh bath in the drum, finally being re-egged either in the same or in a fresh bath, to give the skins the required suppleness.

Oil dressed skins, usually known as chamois leather, may be dyed with any dyestuff suited to leather, but it is customary to employ sulphur dyestuffs which are exceptionally fast to washing. These dyes are insoluble in water and require an addition of sodium sulphide to enable them to dissolve. Sodium sulphide being detrimental to leather, only light soluble sulphur dyestuffs should be employed.

Pigment Finishes on Leather

In accordance with the present general demands in the leather trade, a few words on the subject of "Dope" may not be amiss.

The present high prices of raw skins hardly permit the manu-

facture of black leather, therefore practically the bulk of the supply must be turned into colours to make the output at all remunerative. These conditions have compelled manufacturers to resort to the employment of pigment finishes, which have been introduced during the last decade from America.

There are two distinct classes in the manufacture of pigment finishes. The first may be diluted with water, having principally casein and similar material as a basis. The other class of pigment finishes is composed of an admixture of nitro-cellulose dissolved in highly inflammable liquids, such as amyl acetate, acetone, methylanone, etc. This type of finish can be diluted to a certain degree with alcohol, is perfectly waterproof, and may be considered more of a lacquer or enamel when applied to leather. It is, therefore, not so extensively used as the so-called water pigment finishes.

According to present-day requirements, these finishes should be hardly recognisable as such when applied to leather, and should therefore conform to the following conditions:—

1. The pigments contained in the finish should not have an earthy appearance.
2. The pigments chosen for its manufacture should be of a very light specific weight and be of such fineness that the finish may be applied in a very thin film without the leather losing its characteristic natural grain.
3. It should also possess sufficient covering power, in spite of being bright and fiery in character, and keep well in suspension when diluted with water.
4. Finally, when applied to the leather it should exhibit very good fastness to rubbing, and after hardening possess good fastness to water.

The application of pigment finishes may be performed in

two different ways. By the first method, the prepared solution is applied by means of a plush pad, whereas in the other method the aqueous pigment finish solution is projected onto the leather with the spray. Although the latter method appeared to be favoured on account of its quicker and more regular application, modern chrome upper leather manufacturers have quite recently dismantled their spraying plants and gone back to the old style of hand work. The reason for this is that the dope cannot be worked into the grain of the skin by the spray, whereas with the manual labour the worker can regulate the amount of finish necessary for the requirements of each individual skin.

The method of application necessarily differs for various classes of leather, which cannot all be described, and I will simply give an example of finishing willow calf as practised by a great number of continental manufacturers.

If the skins, when taken from the boards, seem at all fatty to the touch, they ought to be rubbed over with a weak solution of lactic acid (1:10), but the acid must be immediately wiped off again with a dry cloth, otherwise the fixing agents contained in the finishes would decompose and peel off the leather. The finish, when diluted with a suitable acid dye solution and the necessary seasoning, is applied by hand with a plush pad, or, if a spray is to be used, a pressure of 40-50 lbs. should be employed to ensure good penetration.

The skins are then quickly dried and the dope applied for a second time in the same manner as before. Hereafter, the goods are glazed and grained under fairly high pressure on the graining machine. After that, the seasoning proper, in which a goodish amount of formaldehyde (1:12) has been added, is applied. The skins are again dried fairly sharply and glazed for a second time, lightly grained, and ironed.

Basic Intermediates for Dyestuffs: No. XVIII.—Acenaphthene and Its Derivatives

By "Consultant"

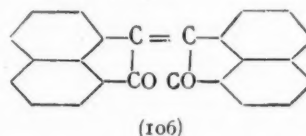
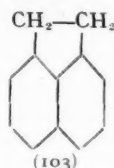
ACENAPHTHENE (103) is one of the hydrocarbons more difficult to isolate from coal tar, owing to the numerous other crystalline hydrocarbons which occur along with it in the same fractions. Thus, simple distillation and crystallisation are almost powerless to effect the separation of acenaphthene from the fractions containing it, i.e., the last fractions of the "heavy oil" and the first runnings of the "anthracene oil." These two are usually mixed and redistilled, the fraction from 275-285° C. being collected apart and allowed to cool, when compact masses of crystals containing about 50 per cent. of acenaphthene separate out. These crystals, drained from adhering oils, are then mixed in equal quantities by weight with the methyl anthracene fraction of coal tar (b.p. 240-260° C.) and the mixture redistilled. Three fractions are collected, i.e.:—

1. Up to 245° C., about 30 lb. liquid.
2. 245-275° C., about 70 lb., depositing 14 lb. of 85-90 per cent. acenaphthene.
3. 275-285° C., about 120 lb., depositing 28 lb. of 60-80 per cent. acenaphthene.

The fractions represent the yields from the distillation of 2 cwt. of the mixture. The 60-80 per cent. acenaphthene is removed from the last fraction and treated again with fresh crude acenaphthene. Further purification of acenaphthene may be effected by recrystallisation from spirit, from which it separates very easily in large crystals, m.p., 95° C., b.p. 278° C.

Acenaphthenequinone

Acenaphthene is never used as such, but finds use in the form of its oxidation products—acenaphthenequinone (104) and acenaphthenone (114). The preparation of acenaphthenequinone is attended by considerable difficulties, especially where direct chromic oxidation is practised, on account of the ease with which it gives rise to naphthalic acid (105), and bis-acenaphthylidenediketone (106).

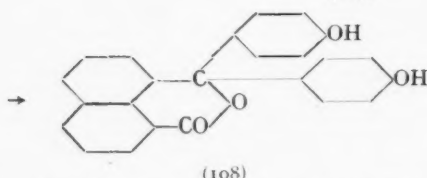
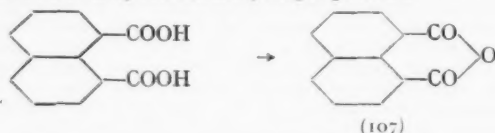


There are two distinct processes for the production of acenaphthenequinone, one involving direct oxidation, giving a yield of 35-40 per cent., and an indirect method involving the formation of the monoxime of the desired quinone by the action of nitrous acid on acenaphthene. The latter process is more expensive, but will give a 60 per cent. yield of good quality acenaphthenequinone.

The Direct Oxidation Method

The direct oxidation process is practised thus: Acenaphthene (22 lb., 85 per cent.) is dissolved in glacial acetic acid (15 gal.), and heated by indirect steam coils in an enamel digester to 95° C. Finely ground sodium dichromate is now added (90-100 lb., 85 per cent.) at such a rate that the reaction proceeds vigorously, but does not get out of hand. The whole batch is stirred vigorously throughout, and stirring is continued for about 15 minutes after the last addition of the dichromate. The mixture is then run into warm water (50 gal., at 80° C.), and, as soon as the inorganic matter is dissolved, the whole is filtered. The filtrate is fractionated to recover acetic acid, and the filter-cake is worked up for acenaphthenequinone. The first step is to remove the

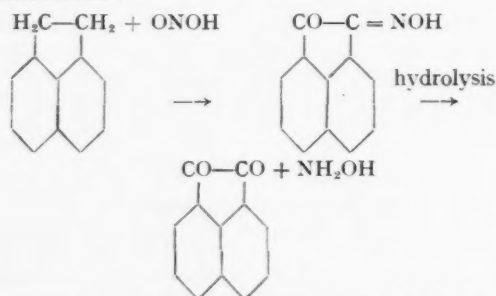
naphthalic acid formed during the oxidation; to accomplish this, the red crystalline cake is heated with 10 per cent. sodium carbonate solution (15 gal.) at a temperature not exceeding 85° C., followed by immediate filtration and washing of the residue. Naphthalic acid can be obtained by acidification of the filtrate, but until recently this has not been practised, mainly on account of the fact that naphthalic acid has very few uses. The recent use, however, of naphthalic acid derivatives as dispersing or "wetting out" agents has led to the recovery of this acid. It forms a sandy, buff-coloured powder, which, like phthalic acid, does not melt, but passes, on heating to 180° C., into naphthalic anhydride (107), m.p. 266° C., a substance which possesses most of the chemical properties of phthalic anhydride, and will condense with phenol to give phenolnaphthalein (108). Acenaphthene or acenaphthenequinone in alkaline suspension can be oxidised completely to naphthalic acid by the use of hydrogen peroxide.



The residue, after the removal of naphthalic acid, contains (besides acenaphthenequinone) acenaphthene, bis-acenaphthylidenediketone and other impurities, from which the acenaphthenequinone is best extracted with sodium bisulphite solution. The crude material is boiled with 40 per cent. sodium bisulphite solution (10 gals.) for ten minutes, filtered hot, and the residue extracted again with a further quantity (4 gal.) of bisulphite liquor. The united extracts contain the acenaphthenequinone in the form of its bisulphite compound, part of which will crystallise out on cooling. The boiling solution of the sulphite compound is decomposed with dilute sulphuric acid and the acenaphthenequinone filtered off, washed and dried. The yield from the quantities specified is 9-10 lb.

The Nitrite Method

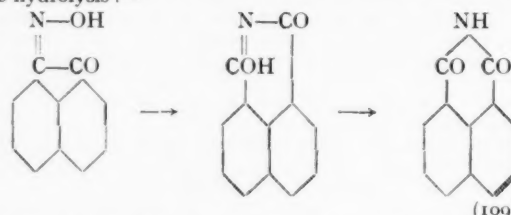
The alternative process for the preparation of acenaphthenequinone may be performed with amyl or methyl nitrite. The acenaphthene (1 cwt.) is dissolved in crude amyl alcohol (5 cwt.), and saturated with hydrogen chloride. After heating to boiling under reflux, amyl nitrite (3 cwt.) is run in (or gaseous methyl nitrite is passed in) at such a rate that the reaction proceeds smoothly. The compounds formed are indicated below:—



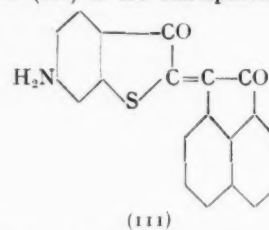
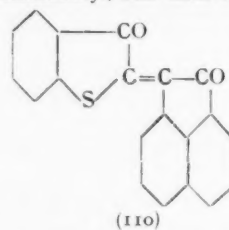
The reaction being completed, water is added (50 gal.) and the amyl alcohol removed by steam distillation. The red mass which remains is ground with caustic soda solution and the filtered solution treated with carbon dioxide, which precipitates the oxime as a red granular powder. This oxime is accompanied by an isomeric substance which on hydrolysis yields naphthalic acid, but in practice it is not customary to separate these. The crude oxime is hydrolysed by boiling with 75 per cent. sulphuric acid (7 parts at 100° C. for one hour) and the acenaphthenequinone separated by dilution with water,

filtration, and digestion with dilute caustic soda solution to remove naphthalic acid, followed by washing and drying.

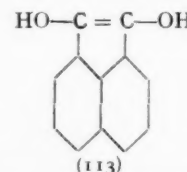
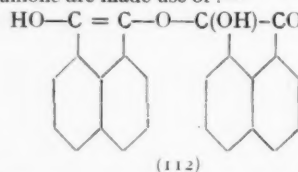
This process is more cumbersome than the direct oxidation, and in spite of the fact that it gives a 50 per cent. greater yield than direct oxidation, the additional expense, except in certain cases, renders this a doubtful gain. One additional source of loss is the conversion of acenaphthenequinone monoxime into naphthalimide (109) by the Beckmann rearrangement, during the hydrolysis:—



Acenaphthenequinone is a yellow, sandy powder, m.p. 261° C. Its chief value is in the preparation of vat dyes by condensation with substances such as indoxyl and thioindoxyl. Thus, Ciba Scarlet G (110) is obtained by condensation with thioindoxyl, and Ciba Orange G (111) is the corresponding



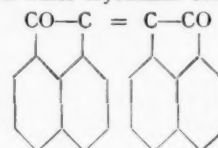
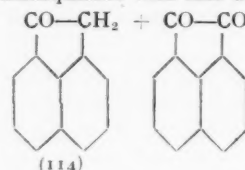
compound from 6-aminothioindoxyl. Numerous patents cover these series of compounds, but two of the more interesting are those of Kalle and Co. (D.R.P. 224,979 and 224,980), in which two intermediates obtained by the reduction of acenaphthenequinone are made use of:—



The compound (112) is obtained as needles, m.p. 248° C., when acenaphthenequinone is reduced with alcoholic ammonium sulphide, and the second compound (113) by reduction with zinc and caustic soda, forming needles, m.p. 254° C. The latter compound will condense with various compounds of the indoxyl class, and is remarkable for having two sets of alkali salts, a colourless mono-series and a deep orange di-series.

Acenaphthenone

A German patent claims the manufacture of acenaphthenone (114) by the action of chloracetyl chloride on naphthalene in the presence of anhydrous aluminium chloride, but there is no evidence that it has been prepared on a large scale by this method. It is usually obtained by the reduction of acenaphthenequinone with zinc dust. It is a white crystalline com-



pound, m.p. 121° C. It condenses readily through the -CH₂ group with aldehydes and ketones, and this condensation accounts for the loss of acenaphthenequinone as bis-acenaphthylidene diketone in the direct oxidation process, since acenaphthenone produced in the first stage condenses with acenaphthenequinone. The benzylidene compound of acenaphthenone yields a blue vat dye on caustic fusion (Kalle, D.R.P. 233,452).

Dyes and Their Application: Recent Technical Progress

By L. J. Hooley

Artificial Silks

THE importance attached to the future of artificial silk is well reflected in the continued attention paid by manufacturers, dyers, and dyemakers to dyeing and finishing processes in connection with it. Although developments in new dyestuffs are following the main lines laid down during the last few years, there is still plenty of ingenuity shown in the new variations which are being brought out. Ether and ester groups are attaining an importance which they have not previously had in dyestuffs, and are being exploited to the full, successive patents showing increasing complexity in the groups used. Some of the compounds may be regarded as attempts to gain a footing in a field which has already been largely filled, while others represent more or less normal developments. Solubilising agents and processes are still important, and new ones are continually appearing. It is at the same time evident, from the chemical constitutions of many of the new products, that primary reliance is being placed on the dyestuff itself, as can be seen by the soluble groups introduced, and probably the tendency will be to use dyestuffs which are sufficiently soluble in themselves, as far as possible.

Dyeing Cellulose Esters

An interesting feature is the attention now being paid to the dyeing and printing of cellulose compounds other than the ones already on the market. These include esters other than the acetate, such as the formate, propionate, and butyrate, and in addition to esters there are ethers such as methyl, ethyl, and benzyl cellulose. It appears therefore unlikely, if any new fibres of this type become sufficiently important to be placed on the market, that they will be handicapped by the absence of suitable dyestuffs, as was cellulose acetate. Judging by the patents which have already appeared, the properties of these other cellulose compounds are very similar to the acetate.

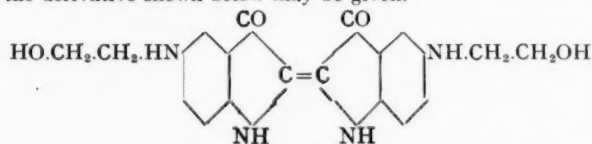
Some examples of recent compounds will be given to illustrate the new soluble groups which have been brought into use. Very great importance is still seen to be attached to amino groups, and these are to be found substituted in a great variety of ways. It is noticeable in many cases, however, that compounds with substituted groups also contain free amino groups.

Different Properties of Similar Compounds

Of course, apart from the question of dyeing properties, there is that of tint and brilliance. Among a series of closely similar products, one or two may stand out from the others in beauty of shade. It is rarely possible to predict which these will be, and actual preparation is necessary before they can be selected. It is sometimes quite remarkable how, among a whole series of very closely similar bodies, only one may be of actual value. While it may be possible to predict the properties of each fairly closely before actual preparation, it will not be possible to decide between them beforehand. This is one of the factors which accounts for the voluminous nature of the patent literature.

Of course, dyes generally start with a preliminary advantage as regards brightness when they are to be used for artificial silk, as the lustre shows them at their best. This, however, does not always apply, especially in the case of dyes which are not specially adapted for artificial silk.

B.P. 285,968 (Dreyfus, H.), is one of the patents dealing with cellulose derivatives considered from the wider standpoint. The products used have —NH_2 or >NH groups in which one or more of the hydrogen atoms are replaced by aliphatic side chains containing hydroxyl groups. As a specific example the derivative shown below may be given.



Special attention may be directed to the hydroxyl group, as this is very frequently present, even if in combination with

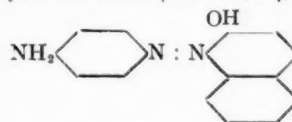
a >CO or >SO_2 group as in —COOH and $\text{—SO}_2\text{OH}$ compounds.

In another patent by the same author (B.P. 285,104) methyl, ethyl, and benzyl celluloses are dyed in aqueous dispersions of insoluble, or relatively insoluble, dyestuffs.

Oxyalkylamino derivatives ($\text{—NH}\cdot\text{CH}_2\cdot\text{CH}_2\cdot\text{OH}$, etc.), are also used in B.P. 275,636 (I.G.F.A.-G.). The compounds are obtained by condensing the amine with chlorhydrins in the presence of sodium carbonate, sodium phosphate, and similar substances.

Very bright shades can be obtained by dyeing with sulphamic acids ($\text{—NH}\cdot\text{SO}_2\cdot\text{OH}$). These may be used with the addition of a little Glauber's salt and acid (B.P. 267,695, I.G.F.A.-G.). In passing, it may be noticed that the sulphamic acids have recently been found very convenient for the diazotisation of diamines or polyamines when it is not desired to diazotise all the groups.

The British Alizarine Co. have found citric acid of use in the preparation of acetyl silk dyes from amines. Among many examples a brown product from *p*-amino-benzene-azo- β -naphthol may be mentioned (B.P. 281,114, Barnard, C. M.).



Amongst some varied methods may be mentioned G. P. Application 56,911, where greater fastness to rubbing is obtained by dyeing in the presence of sulphurised phenols.

Damage to wool and cellulose acetate and similar substances in dyeing with indigo or vat colours is avoided in B.P. 274,559 (J. W. Leitch and Co., Everest, A. E., and Wallwork, J. A.) by the use of alkali salts of the higher fatty acids, especially such as stearin soaps.

A revival of the use of swelling agents is seen in B.P. 285,942, where Dreyfus makes use of these in conjunction with solubilised dyestuffs. The patent is very wide in scope both as regards the dyestuffs, the dispersing agents, and the swelling agents which may be used. Under certain circumstances the dyeing may be done at $30\text{--}40^\circ\text{C}$.

Molasses are recommended for use in the preparation of dyestuffs for acetyl silk in B.P. 271,550 (I.G.F.A.-G.). The dyestuff in strong paste form may be ground up with the molasses and a little water, and a certain proportion of sulphite cellulose liquor, may also be added.

Immunised Cotton

The preparation of dyestuffs for this specially treated cotton is described in B.P. 276,100. As is known, immunised cotton is close to acetyl silk in its general dyeing properties, in spite of the fact that the one is obtained by the use of a sulphonic chloride and the other by an acetyl compound. The patent follows general lines for preparing colours in dispersed or solubilised form, and from the list of dyestuffs included as well as the substances which may be used in their treatment, there appears to be very little difference in the preparation of dyes for this purpose and for cellulose acetate.

As the immunising process is only a surface effect, it is necessary to take care, in any treatment which the fibres have, that this surface is not removed. The fibres are, however, more resistant than cellulose acetate, as they can be boiled.

Consisting of a central core of cellulose surrounded by an annular layer of cellulose ester, this fibre should prove very interesting for the investigation of dyeing phenomena, especially of the effects at the boundary between the two and of the manner in which the colour is distributed.

The cotton, can of course, be immunised either before or after dyeing, but only a selected range of dyestuffs can be used for this purpose. Such material, immunised after dyeing, can be woven with a white material and then the white dyed without affecting the coloured thread, provided, of course, that suitable dyestuffs are chosen, these belonging principally to the Direct Colours, Sulphur Colours, and in some cases Vat Colours.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

The dyestuff turnover in April was well up to the average of the earlier months of the year, and on the whole, therefore, it may be said that there is some justification for the optimism created in certain quarters by the steady though slow progress obtaining in the textile trades. The pale shade vogue still holds in the home trades; ladies' hats are of minimum size and skirts are of minimum length, all of which have an important bearing on the amount of dyestuff used. On the other side of the scale, it is probably true that the large majority of women have never before possessed such a store of clothing as they do to-day or, alternatively, that they have never before indulged themselves in such frequent purchases of new clothing. A change in fashion, which is bound to come, must benefit the dyestuff manufacturer, as shades cannot become paler nor clothing scantier, and the modern woman's wardrobe is scarcely likely to become less extensive.

The use of dyed leather in sports clothing generally is steadily increasing and it would appear that there is every likelihood of the establishment of a permanent and large trade in such garments. Prices will have to come down considerably before a popular demand is created, but there is no fundamental reason why this should not occur.

The adoption of fabric for motor-car bodies has meant a great deal to the leather cloth trade in which the Manchester area can claim to be well represented and, incidentally, has created a new and important outlet for dyestuffs. Motorists in general are so pleased with the advantages gained that there can scarcely be any doubt as to the permanency of this new market for dyestuffs.

The spinning side of the cotton trade is still considering ways and means of setting its house in order. The Cotton Yarn Association's idea of a combination of spinners of American cotton would appear to have aroused a great deal of interest, but so far it has not been possible to make any definite arrangement. In the meantime the calling up by many mills of the unpaid portion of the share capital continues, and there must come a time shortly when such action will bring in relatively little owing to sheer inability of the shareholder to pay. Another scheme whereby the operatives were to work longer hours for less pay has met with the definite refusal of the labour representatives. Refusal or acceptance probably has little bearing on the fundamental features of the problem. On the whole there is little basis for optimism, but yet it scarcely seems credible that an industry of such importance will be content to have such a muddle in its midst indefinitely.

During the month the first two scholarships have been granted under the Herbert Whitworth scheme for the training on broad and generous lines of carefully selected entrants into the cotton export trade. The scheme includes experience abroad and should eventually lead to a supply of men of the outstanding ability which is undoubtedly necessary for the successful handling of modern industrial problems.

Yorkshire

Considering the relationship of the trading of April to that of the preceding months of the year, one is struck by its similarity to the conditions of last year. The market report in these columns then stated that after the progressive increasing turnovers of January, February and March, that of April was decidedly disappointing. So it is this year. In the absence of any more convincing explanation, Easter must be given as the reason. It is hoped so, for a repetition of shrunken turnovers in May would be most discouraging.

Last month all unsuspecting, except for a little uncertainty as to the effect of the Automobile Association's petition to Parliament, we made reference to a recent reduction in the price of petrol, and remarked that no sympathetic change in the price of benzol had been observed. Slow to respond to a downward movement, it was the reverse as regards an upward one, and those buyers not covered by contract found themselves faced with an increased price the day after the Chancellor of the Exchequer introduced his Budget. Although the benzol produced in this country is not directly affected by the new Budget, the producers would appear to hold that an advance

of fourpence per gallon in the circumstances is justifiable. Production and sale during the long period, five years of decreasing and depressed petrol prices, at uneconomical figures is one of their pleas. The effect on the cost of manufacture of intermediates will be very material, and may result in price increases of intermediates, although none is in evidence as yet.

Increases in the prices of xylene were reported last month and were probably due to an increased demand for cellulose varnish manufacture. Further advances since the Budget have been strongly in evidence, and the demand remains good.

The protracted wages dispute in the dyeing and finishing section of the textile industry, which has been going on since January of 1927, has now become involved with a serious development in the shape of a wages "cut" although small, due to the fall in the Board of Trade's index figure of the cost of living. The secretary of the executive committee of the unions has sent a communication to those employers whose operatives are at present on day rates, informing them that unless a satisfactory agreement is reached before the first pay day in June, 1928, the operatives will be called upon to cease work on the following pay day. It is stated that there are from 800 to 1,000 operatives in the dyeing industry in Bradford who are on day rates of wages, and are, therefore, directly affected by the union's proposals set out in the communication to the employers referred to above. The majority of the firms paying day rates are in the Huddersfield district, but there is a number in other parts of Yorkshire and in Lancashire, Cheshire, Derbyshire, and Scotland. There are approximately 85,000 operatives in the industry as a whole, but it remains to be seen whether all these will be involved.

Scotland

WITHOUT showing any great difference from last month, the trade outlook at the beginning of May remains fairly good. Employment on the whole has been well sustained, and in one or two cases exceptionally good. Although business has not been quite so good in the Glasgow district, it has remained excellent at Paisley and Lennoxton, and dyers and calico printers as well as bleachers and finishers have had a fairly satisfactory time. Dyestuffs sales remained steady.

The damage done in the recent fire at the Thornliebank works is stated to amount to £30,000, but is not expected to have much effect on the output of the works.

A meeting of the Federation of the Scottish Dyers and Bleachers was held in Glasgow during the month on the question of the new wages agreement; this was only in the nature of a preliminary discussion.

Morton Sundour Fabrics have purchased Cree Mills, Newton-Stewart, for the extension of their activities. The acquisition is welcomed in the neighbourhood, as the mills, which were formerly occupied in the tweed trade, have been closed for some time, and it is expected that the change-over will mean a considerable improvement in employment.

The rumours which have been current with regard to Scottish Artificial Silks and J. and P. Coats have called forth a statement from the former to the effect that no approach has been made to them by Coats.

The woollen trade remains in a satisfactory condition, orders from the United States having been a prominent feature.

The Scottish tweed manufacturers are deservedly jealous of the reputation of their goods, and resent the application of the term "Scotch tweeds" to materials which have not been made in Scotland, as this has not only the disadvantage of taking business, but in many cases the alleged goods are inferior in quality and so cause a double injustice. A National Association of Scottish Woollen Manufacturers for the protection of the industry and the avoidance of the difficulties just mentioned, was agreed to at a meeting of Scottish woollen manufacturers held recently in Edinburgh. The new association will probably absorb two or three older ones. It is hoped to put it on such a basis that it will be able to cope with all the matters affecting the industry's welfare, and one of the first steps will be to endeavour to protect by law the use of the words "Scotch" and "Scottish" as applied to woollen materials for goods which have actually been manufactured in Scotland.

Dyestuffs Monthly Supplement

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Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

I.C.I. and Dyestuffs

IN discussing the various branches of industry covered by Imperial Chemical Industries, Ltd., at the annual meeting of the company last week, Sir Harry McGowan (Deputy-Chairman) made a reference to the dyestuffs industry, which he described as of national as well as of particular interest. The industry, he reminded the meeting, is a highly specialised one—one requiring the closest co-operation between the user and the maker—and he was glad to say that with that co-operation substantial progress has been made, both technically and commercially. Some, he remarked, may have expected the British Dyestuffs Corporation to do everything that others can do in the dye industry; not only that, but to show equal, or even better, results in price. Consumers have contended that they must be assured of the best quality and range, and that for this purpose they must have access to all sources of supply; that they must pay prices not higher than those paid by their competitors in the world markets; and that by home development, security of supply must be assured in the event of international disturbances.

Suggested Preference

"If," Sir Harry McGowan stated, "the consumer wants the home output maintained he ought to be willing to concede that we do not work at a loss, given, of course, that he is satisfied with our efficiency, and he should be ready to give us some preference as an incentive to the maintenance of that output. We acknowledge heartily all the help given us in the past, and we hope for a continuation of that help and sympathy in our struggles in the dyestuffs industry, which are by no means over. We are not afraid of failure to give every satisfaction on questions of quality and service—we are improving all the time—and with the help at hand in the organisation of Imperial Chemical Industries, we see every prospect of accelerating that improvement, provided we can get output—that is our real difficulty—to get work enough to fill the factory to its best economic capacity." As regards preference, the industry already enjoys, under the licensing system, a certain degree of protection against foreign competition, and that protection has still some years to run. Whether the preference suggested by the Deputy-Chairman of the I.C.I. is a continuance of the Dyestuffs Act for a further period when it expires, or some extension of the safeguarding system beyond its present limits, is not quite clear, but in view of the progress of the past few years in establishing the British industry, public opinion would be all in favour of giving those responsible for it reasonable support. The best support that can be given, however, is a sufficient stream of orders to enable the productive plants to work to their best economic capacity, and that must come mainly from the textile industry.

British Dyestuffs Production

ALTHOUGH we have nothing yet in this country comparable to the United States Dyestuffs Census, the annual return now made by the Dyestuffs Development Committee and published within a reasonable date of its completion is welcome, both as an interesting piece of information and as evidence of the continued growth of the industry. The total output for 1927 as based on returns furnished

voluntarily by the principal British dyestuffs manufacturers was 39,551,756 lb., a total that compares favourably with 30,292,000 lb. in 1926, and is, in fact, the largest total of production yet attained in this country. The increase in the production of vat dyes testifies to the growing demand for fast colours, and there was a marked advance in sulphur colours. The total production for 1927 was in the following proportions:—Direct cotton colours, 5,615,607 lb.; acid wool colours, 6,233,179 lb.; chrome and mordant colours (including alizarine), 7,502,229 lb.; basic colours, 2,014,806 lb.; sulphur colours, 7,117,233 lb.; vat colours (including indigo), 8,818,923 lb.; dyestuffs for lake making, 1,138,375 lb.; oil, spirit and wax colours and miscellaneous, 1,111,404 lb.

Two New Caledon Colours

SCOTTISH DYES, LTD., of Grangemouth, announce the issue of two new Caledon colours, providing valuable shades between orange and red, namely, Caledon Yellow 5R and Caledon Brilliant Orange 4R. Caledon Yellow 5R gives bright reddish tones of yellow, considerably redder than Caledon Yellow R, and Caledon Brilliant Orange 4R gives exceptionally bright shades coming in between Orange RRT and Red 5G. On the pattern card sent out, the effects are particularly beautiful on mercerised cotton and viscose yarn, while samples of the application of the dyes to cotton and printed on mercerised cotton are also shown. Both of these new colours are hot dyeing colours, but to obtain the full advantage of the redness of the Brilliant Orange 4R this should be vatted and dyed at 50°. They are described as having excellent solubility and level dyeing properties, and as capable of being used in all types of dye machines. As regards fastness, Caledon Yellow 5R is described as very good to light, excellent to chemic, good to washing and moderate to kier boiling. Caledon Orange 4R is stated to be excellent to chemic, and very good to light, washing and kier boiling. They both print readily by the potash method, giving full shades. In combination with Caledon Blue RC excellent reddish grey shades may be obtained. Both colours are suitable for dyeing viscose or natural silk.

A New B.D.C. Colour

IMPERIAL CHEMICAL INDUSTRIES announce the issue from the works of the British Dyestuffs Corporation of Chlorazol Rose B, the latest addition to the B.D.C. range of direct cotton colours. This colour gives bright pinks, intermediate in shade between Chlorazol Fast Eosine B and Chlorazol Fast Pink BK. It is suitable for application to all types of cotton material and for machine dyeing, particularly for dyeing cotton pieces. One of its characteristics is its fastness to alkaline storage. It is said to be easily dischargeable by the Rongalite process and as such will appeal to calico printers for the production of dischargeable ground shades. It is suitable for dyeing artificial silk and paper and for dyeing the cotton in cotton-acetate silk materials, leaving the latter unstained in light to medium shades. Dyeing is carried out in the manner usual for direct cotton colours.

An American View

In our last Monthly Dyestuffs Supplement, reference was made to the review of British Chemical Industry in 1927 by Mr. Homer S. Fox, United States Trade Commissioner in

London. Dealing with the production of dyestuffs, Mr. Fox states that the 1926 output, figures for which were published at the end of 1927, amounted to 30,292,000 lbs., as compared with 32,693,402 lbs. in 1925. Production in 1927 has probably been somewhat above that for the preceding year. The chief features of the latest output figures are the reduction of 23 per cent. in production of vat blues, reflecting the lower output of synthetic indigo; a 25 per cent. decline in production of sulphur black; and a general increase in the range and quantity of the vat colours other than blues and browns. It is estimated that Great Britain now produces about 10 per cent. of the world's output of aniline dyes, as compared with 3 per cent. in 1913, while the estimated capacity is more than twice the actual output.

The leading dye-making concern, Mr. Fox adds, in the United Kingdom is the British Dyestuffs Corporation, now a part of Imperial Chemical Industries, Ltd., Scottish Dyes, Ltd., also being included in this group. It seems generally considered that the position of the dye industry has been greatly strengthened by the formation of Imperial Chemical Industries, with consequently greater financial and technical resources. During the year the British Dyestuffs Corporation establishments have been reorganised and centralised at the Huddersfield and Blackley works, with extensions at these works as well as at the Grange-mouth works of Scottish Dyes, Ltd., the latter particularly for the manufacture of anthraquinone colours. There are a number of other important British dye-making firms, and there seems some likelihood that one or more of these firms may be absorbed from time to time by Imperial Chemical Industries, Ltd. The name of the British Alizarine Co. has been mentioned in this connection, although no official statement has been made.

Costs and Prices

On the subject of costs and prices, Mr. Fox observes that an event of importance in connection with dye prices was the reduction, coming into effect on September 1, 1927, of from two and one-half to twice times the pre-war price, in the factor employed for determining applications for dyestuffs import licenses on price grounds. This reduction is taken to indicate a lowering of British costs of production, as well as being of advantage to domestic consumers. Further substantial reductions in production costs are naturally dependent in part upon increased output, which in turn is largely dependent on the development of exports.

Production capacity in the British dye industry is much greater than home requirements plus exports at the present rate, and while satisfactory progress is reported in the growth of the home demand for British dyes, the dye export trade does not show the same favourable position. During the last two years, in fact, British exports of coal-tar dyestuffs have been at only 75 per cent. of the rate in 1924 and 1925, while imports have tended to increase, from the standpoint of value, although the quantity increase in 1927 over 1926 was slight and the total quantity imported last year was only a little more than half the corresponding receipts in 1924. Progressive reductions in the import price factor are anticipated, nevertheless, during the three years which the Dyestuffs (Import Regulation) Act has yet to run, the hope being expressed that at the expiration of this period the British industry may be in a position to meet competition without further artificial assistance.

Average selling prices of British dyes are not available, but an indication of the trend may be gained from the average values of imports, which during the last three years have shown a tendency to increase. This increase, however—from approximately 86 cents per pound in 1925 to 96 cents in 1926 and \$1.04 in 1927—is attributed in the trade to the larger use of the fast and higher-priced colours.

Technical Progress

Generally speaking, the range and quality of dyes made in Great Britain is being rapidly extended and improved, both in producing original new colours and in adding to the list of home-produced dyes those formerly supplied only by imports. Among new dyes those developed by the British Dyestuffs Corporation for the even dyeing of viscose silk and for the dyeing of leather are outstanding. A number of producers have made important additions to their azo, pigment, and other series. Considerable progress has also been made in the extension of the technical service rendered by producers to the colour-using industries.

Imports and Exports

British dyestuffs exports in 1927 were at practically the same rate as in 1926, exports in each of the last two years having been at about 75 per cent. of the rate in the two preceding years. The total value of the 1927 exports showed an increase of about 5 per cent.—possibly, as in the case of imports, reflecting a higher average quality.

While detailed figures for 1927 are not available, it may be said that on the basis of figures for preceding years approximately half (by value) of British exports of finished dyes go to Empire countries (48 per cent. in 1926, constituting about 34 per cent. by weight), chiefly to Australia, India, the Irish Free State, and Canada. During 1927 Australia brought its dye import regulations more into line with the procedure of Great Britain by providing for the prohibition, except under license, of imports of dyes of other than British origin. Among foreign countries, France, Belgium, and the Netherlands on the Continent and China and the United States are some of the principal buyers of British dyes.

The great bulk of imported dyes comes from Germany and Switzerland, these two countries having supplied 98 per cent. of the total quantity of dyestuffs for which license imports were granted in 1926. Imports of finished coal-tar dyestuffs in 1927 represented about half of the corresponding exports.

Jamaica's Logwood Dyes

The logwood dye industry, like the natural indigo industry, was bound to suffer from the production of synthetic dyestuffs. In Jamaica something like a crisis is reported, and a movement has been started to obtain the co-operation of the Government with the producers and manufacturers of logwood extract to improve the position. Jamaica exported in 1926 30,239 tons of raw logwood and roots—17,148 tons to France, 11,422 tons to the United States, 1,605 tons to Germany, and 64 tons to the United Kingdom. It also exported 7,197 packages (3 cwt. net each) of logwood extract—4,617 packages to the United Kingdom, 333 to the United States, 1,820 to Belgium, 402 to Italy, and 25 to Spain.

Logwood extract provides a fast black dye, which is largely used in the United States, but owing to competition between the extracting firms the price of hematine crystals has fallen in recent years from £105 per ton (United Kingdom) to £86 per ton, which is not a paying figure. Owing to the practice of foreign countries taking the raw logwood and making the extract, the native industry is seriously threatened and means are being sought to save it from extinction.

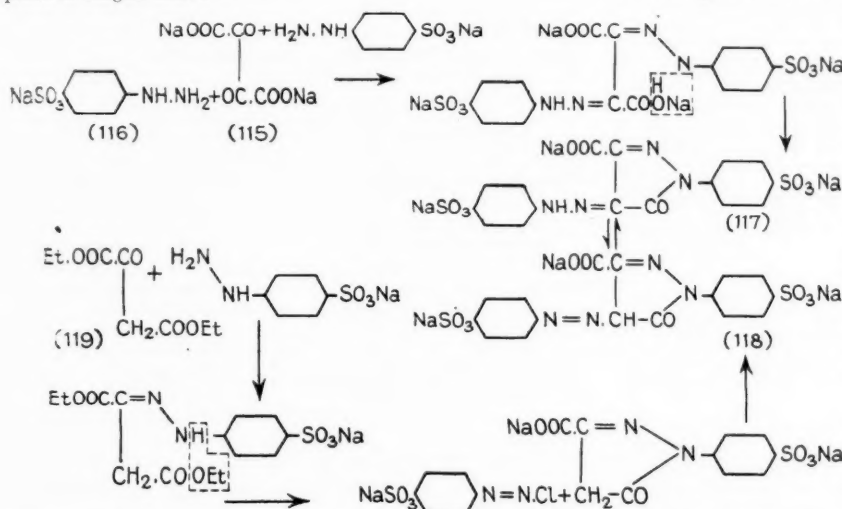
It is doubtful (in the opinion of a writer in *The Times Trade Supplement*) whether logwood dyes will ever regain the British market for use with cotton, as sulphur blacks cost less and are probably more effective as well as being easier in working. For dyeing weighted blacks upon silk and for wool, logwood dyes are probably superior to any other. It is in wool that the largest quantity of this dye is employed in this country.

Basic Intermediates for Dyestuffs: No. XIX.—Tartrazine and its Intermediates

By "Consultant"

THE manufacture of the important yellow dyestuff Tartrazine is so closely bound up with that of its intermediates, that it becomes almost a necessity to deal with the subject as a whole, rather than to discuss separately the various intermediate substances in the sections in which they fall by chemical classification.

The intermediates involved, of course, depend upon the process decided upon for the preparation of Tartrazine, and as a general rule one of the two processes described below is chosen. The British practice involves the condensation of the sodium salt of dioxytartaric acid (115) with that of phenylhydrazine-4-sulphonic acid (116), a process which takes place in stages, thus:—



while many of the German works prefer the condensation of phenylhydrazine-4-sulphonic acid with oxalacetic ester (119), when, as shown above, the simple hydrazone is formed. This with alkali gives the pyrazolone ring, and treatment with the diazo salt of sulphanilic acid gives Tartrazine, which, it will be observed, may be represented by either of the tautomeric formulæ shown in (117) and (118). It is not settled which formula most accurately represents the actual dyestuff, or whether the latter exists as an equilibrium mixture of the two forms, but the tendency is to regard Tartrazine as derived from the "azo" formula (118).

Dioxytartaric Acid

Dioxytartaric acid is best prepared by the oxidation of tartaric acid, a process very easily accomplished by the action of nitric acid. The tartaric acid (56 lb.) is very finely powdered and sifted, with continuous stirring, into a mixture of oleum (30 per cent. : 35 lb.) and 98 per cent. sulphuric acid (28 lb.). The charge is contained in an enamelled iron pan fitted with a cooling coil as well as with adequate stirring gear. Nitric acid of 62 per cent. strength is gradually run in (70 lb.) at such a rate that the temperature does not rise above 20° C. After the addition, the stirring is continued for another three hours, at the end of which cracked ice (3 cwt.) is stirred in, and the stirring continued during the next 48 hours. During this period the oxidation takes place, and both heat and nitrous fumes are slowly evolved; and the charge is found to be slightly warmer than the temperature of the surroundings, even at the end of the two days. The whole batch is neutralised with sodium carbonate crystals, and the sodium salt of dioxytartaric acid which separates is filtered off, washed, and dried at a very gentle heat, or preferably used immediately in the wet, pasty condition.

Dioxytartaric acid itself is very difficult to isolate, and when obtained is unstable; the sodium salt, however, in addition to being very insoluble in water, is more stable, and,

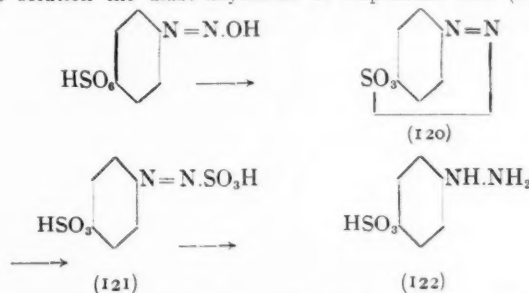
when dry, will keep indefinitely. The free acid is used for the detection and estimation of sodium in analytical practice.

Phenylhydrazine-4-sulphonic Acid

Although one or two patents have been granted covering the manufacture of phenylhydrazine-4-sulphonic acid by the direct sulphonation of phenylhydrazine, this process is of no practical value. Works practice invariably involves the reduction of the diazo-compound of sulphanilic acid. The sodium salt of this acid ($\frac{1}{2}$ cwt.) together with sodium nitrite (14 lb.) are dissolved in water (12 gall.), and in order to cool the liquid, cracked ice (1 cwt.) is added. Whilst this solution is cooling, a batch of diluted sulphuric acid is prepared by

running 98 per cent. acid (34 lb.) on to a mixture of ice (1 cwt.) and water (10 gall.). The acid is constantly stirred, and when the temperature has reached 0° C. the solution of sodium nitrite and sulphanilic acid is slowly run in, the temperature not being allowed to rise above 5° C. The diazo compound which separates out in minute orange-yellow crystals is filtered off and washed. There is, of course, some slight danger of the diazo compound exploding, but this is quite negligible if care is taken to keep the product quite wet throughout. The paste of diazo compound is mixed with a little water and reduced with sulphite solution. Some advocate the use of neutral sulphite for this purpose, but it is more usual to use an acid sulphite obtained by dissolving 60 lb. of the neutral sulphite in water (60 gall.) and saturating with sulphur dioxide. This, of course, corresponds to a

17 per cent. solution of acid sodium sulphite, and may be prepared by a suitable dilution of the usual 40 per cent. bisulphite liquor. The diazo compound dissolves in the sulphite liquor with a yellow colour, and there is present in the solution the diazo-anhydride of sulphanilic acid (120),



which is converted to the diazosulphonic acid (121), and then reduced to phenylhydrazine-4-sulphonic acid (122). The progress of the reduction may be followed by observing the disappearance of the yellow colour. When the reaction mixture is quite colourless, the reduction is completed by the addition of hydrochloric acid (1 cwt.) to liberate sulphur dioxide, and the liquid is then evaporated until crystals appear on the surface. On cooling, the crude phenylhydrazine-4-sulphonic acid separates out, and can be purified by recrystallisation from hot water.

Oxalacetic Ester

The only economical process for the preparation of oxalacetic ester is the condensation of the ethyl esters of oxalic and acetic acids in the presence of sodium ethylate, in much the same way as ethyl acetate is condensed with itself in the preparation of acetoacetic ester. The condensation may be

carried out in enamelled digesters fitted with stirring gear and reflux condensers. Toluene (10 gall.) is placed in the digester and sodium added in large lumps (6 lb.). The toluene is boiled and the mixture of toluene and molten sodium is stirred rapidly until an emulsion has formed, when it is allowed to cool to room temperature. Ethyl acetate (22 lb.) and ethyl oxalate (46 lb.) are then added, followed by the addition of small quantities of absolute alcohol (not more than $\frac{1}{2}$ gall. in all). The addition of this alcohol must be regulated by the experience of the operator, since a too rapid addition may induce the reaction to proceed tumultuously with loss of yield, and when added too slowly the reaction may not proceed to completion.

When the reaction is completed the toluene layer is washed with a little water, dried, the toluene removed by distillation under partial vacuum, and finally the crude oxalacetic ester distilled in vacuum. At 22-24 mm. it boils at 130-132° C. The yield depends to a large extent on the skill of the operator, and for the quantities mentioned should not be less than 45 lb. before fractionation.

The Tartrazine Condensation

Both methods of Tartrazine condensation were worked out by Ziegler, the dioxytartaric acid method being the earlier of the two. In this process the sodium dioxytartrate (20 lb.) is mixed with water ($3\frac{1}{2}$ gall.) and heated to 40° C., at which point hydrochloric acid (2 gall.) containing 33 per cent. of HCl is run in. This gives a solution containing the free dioxytartaric acid. A second solution is then prepared in an enamelled pan, containing enough phenylhydrazine-4-sulphonic acid paste to correspond to 40 lb. of the dry substance, together with water (12 gall.) and caustic soda (6 lb.). The solution of dioxytartaric acid is added to that of the phenylhydrazine-4-sulphonic acid, and the whole stirred at 80° C. for an hour, at which temperature the condensation takes place fairly rapidly. It is then allowed to stand at room temperature until the next day and filtered off at the press. Purification is effected by dissolving the dye in dilute aqueous sodium carbonate solution and reprecipitating with dilute acid.

The second method of condensation is a rather more lengthy process. The phenylhydrazine-4-sulphonic acid (19 lb.) is suspended in water (10 gall.) and crystalline sodium acetate (15 lb.) and oxalacetic ester (19 lb.) are added. This reaction mixture is heated at 45-50° C. until a clear solution is obtained, a result which is usually accomplished in a few minutes. The liquid is then cooled to ordinary temperature and sodium carbonate added until the reaction is definitely alkaline (usually 17-20 lb. is required). The elimination of alcohol and the formation of the pyrazolone ring take place quite rapidly even at this low temperature on stirring, and samples are withdrawn from time to time and acidified with sulphuric acid. When the sample shows an unalterable maximum of precipitate, ring formation is adjudged complete, and the whole of the intermediate compound is precipitated by the addition of dilute sulphuric acid. The filtered and washed paste is dissolved in water so that an 8 per cent. solution is obtained, and caustic soda is added in quantity equal to half the weight of the intermediate compound used. The solution is heated to 70° C. for an hour, cooled, and sodium acetate added, followed by an ice cold solution of diazotised sulphanilic acid. After standing 24 hours the Tartrazine is filtered off and purified, as above.

There is very little to choose between these two processes on the score of comparative yields, which are very good with both. The cost of the labour and intermediates is therefore the deciding economic factor, and there seems little doubt that the dioxytartaric process is the cheaper. In addition to being simpler to operate, it does not involve the somewhat costly preparation of oxalacetic ester; its only drawback is that it uses exactly twice as much phenylhydrazine-4-sulphonic acid as does the oxalacetic ester process, which, however, is not in practice a very serious drawback.

New Fire Extinguisher

A NEW fire extinguisher, in which an inert gas and a dry powder are used to form a cloud of insulating powder, was demonstrated at Leeds on Friday, June 1. The apparatus can be used as effectively on burning petrol, calcium carbide, and delicate fabrics as it can on moving machinery.

Level Indanthrene Dyeing *Remedies for Common Troubles*

WHEN, as the result of Indanthrene dyeing, a piece has acquired too dark a colour, there is only one remedy. It must be treated for 15-20 minutes in a bath at about 70° C. containing $\frac{1}{2}$ g. concentrated hydrosulphite powder and $\frac{1}{2}$ cm. soda dye of 40° B. per litre; if the dyeing has been done by the cold process this improving or levelling bath should also be cold.

In most cases this will prove sufficient to brighten the tint, though it may be necessary to renew the bath so as to prevent any reabsorption of discharged dye.

The same method will be effective in levelling spotted or striped pieces, but as it will not be successful in every case it is advisable to attend to certain preventative measures in the dyeing itself and in the pre-treatment. Firstly, it is most important that the fabric should be properly degummed. If, further, it has been bleached, care should be taken in bucking that both material and bucking liquor are well aerated, so as to avoid oxycellulose formation.

Very hard water will produce lime spots which become undesirably conspicuous in dyeing. Too strong bleaching baths and also the presence of catalytic agents, such as iron and copper fittings in the bleaching kiers and machines, will also give rise to oxycellulose.

It is, in any case, safer to bleach with sodium hypochlorite than with chloride of lime. If powders are used in the dyeing these should first be made into a paste with Monopol oil, though no dry spots must be left in the paste, for these do not readily dissolve in the dyeing liquor and unevenness may result.

The paste should be sludged with about ten times its amount of water as free from lime as possible, and then strained through a fine sieve or filter cloth, before passing into the bath, to which has already been added soda lye in proper quantity.

Colour Measurement in Dyestuffs

IN America, one research association alone has 9,000 specimens, involving 550 different dyes, under observation for fastness to light, whilst in this country the woollen, silk, and cotton industries are also carrying out hundreds of tests. Germany also has elaborate researches on the subject in progress.

The advantage of being able to correlate all the results obtained in terms of an accepted standard is obvious. Much certainly remains to be done before that stage can be attained, but it can be said that the necessary foundation has been laid, the various factors involved have been investigated, and a fairly accurate estimation made of their relative importance. The purely scientific investigator can, therefore, reasonably expect the technologist to make use of the instruments already devised. For popular use it will always be the custom to provide a colour with an attractive name, and we shall always in ordinary conversation compare colours with flowers and other productions of nature. There is, however, no more reason why when dealing with the purely technical and commercial aspects of an object we should be any more vague about its colour than we are about its length or weight; indeed, one might reasonably argue that an increased knowledge of colour and its composition would increase rather than decrease our purely aesthetic appreciation of it.

"Mulsoid" on the American Market

INDUSTRIAL Processes Development, Ltd., has just arranged the financing and incorporation of a new company, Mulsoid Products Corporation, with head office and plant at Ogdensburg, New York State, to manufacture and supply various brands of "Mulsoid" to the textile, laundry and dry-cleaning industries in the United States. "Mulsoid" is a scientifically designed scouring and cleansing agent, originally developed in Great Britain. It is claimed to have unusual properties for dissolving grease and removing dirt, and is finding an increasing market in the textile and laundry industries in Great Britain and Canada, and now in the United States. It is manufactured and sold in Canada by the Dye and Chemical Company of Canada, Ltd., Kingston. Industrial Processes Development, Ltd., hold the patent rights for "Mulsoid" in the principal countries of the world.

Modern Methods of Leather Dyeing

By F. T. Herndl

Below are given some additional extracts from the paper presented to the Leathersellers' Conference in London on Modern Methods of Leather Dyeing, by Mr. F. T. Herndl, Leather Trades Chemist to the Society of Chemical Industry in Basle. The first extracts appeared last month.

The dyeing of lighter skins such as chrome goats, sheep, kid and lamb skins, is efficiently carried out in the drum. In preparing the dyebath, care should be taken that the skins have sufficient float to ensure level dyeing. The surface to be dyed being much larger than with heavier leather, the amount of water necessary is three to five times the shaved weight of the leather, according to the substance and size of the skins.

When charging the drum, the skins should be unfolded or well opened out, and entered singly into the dyebath. For the dyeing of this class of leather, acid dyes are chiefly employed, but direct dyes, either alone or in combination with acid dyes, also find extensive use.

Some kid manufacturers plump their produce with a small quantity of gambier or mimosa, whereas others prefer to dye the skins without the addition of any vegetable mordant. This plumping is usually adopted when the skins are of meagre appearance owing to faulty tanning, or of naturally inferior quality. Basic dyes are now very rarely used as a second bath since the introduction of pigment finishes. For the production of light fashionable shades, a new class of patented dyestuffs has been introduced to the leather trade by the Society of Chemical Industry in Basle, under the name of Neolan Colours.

The production of pale shades on leather has always proved a sort of *bête noir* to the leather dyer, obliged to work with weak dye solutions which are generally absorbed too quickly by the leather fibre to ensure level dyeings. To retard a too rapid striking of the dyestuffs on the leather, an addition of soap and sumac must be resorted to, which practice is, however, not always expedient, as it causes a rather poor and hungry appearance of the dyeings.

Neolan Colours

Through the introduction of the Neolan Colours the production of pale fancy shades has become child's play on all classes of leather. In weak solutions, these colours dye exceptionally level, and the flesh does not become darker than the grain; therefore, faulty grain is not accentuated, as when other dyestuffs are employed.

A further great advantage of the Neolan Colours is that primary colours may be used in combination for the successful production of every pale shade required. This means that with red, yellow and blue, strikingly level dyeings of grey, beige, putty, and stone shades may be produced. The method of dissolving this new dyestuff differs slightly from other dyes, but by strict adherence to the instructions given for dissolving Neolan Colours, a combination of certain colours will act like a homogeneous dyestuff. When Neolan Colours are used in mixtures, they should always be dissolved together, preferably mixing the powder before boiling water is poured over it. It is imperative that the solution should be boiled for a few minutes prior to being added to the dyebath. Neolan Colours do not permit combination of stock solutions, as the resultant dyeings are not satisfactory.

Dyeings of Neolan Colours on chrome leather are fast to light and washing, which is of great advantage to the consumer. These colours have now been adopted by a large number of modern leather manufacturers, and have already achieved great success in the art of leather dyeing. They are only suitable for the production of all light shades, and may be successfully applied on all kinds of leather, such as nacco calf, glacé kid, chrome sheep, semi-chrome Persians and all classes of vegetable tanned leather for the fancy leather trade and also for brush dyeing on velvet hides.

Vegetable tanned leather, when bought in the crust, may have been kept in stock for various lengths of time, causing thereby oxidation of the tanning material still adhering to the surface of the leather, which prevents the dye being readily absorbed by the leather. It is, therefore, advisable to subject the leather to one or two hours tumbling in plenty of luke-warm water. If the goods are of overseas tannages, it is well to strip them with a small quantity of some mild alkali, such

as borax, in order to cleanse them from dirt and grease. This scouring should be followed by a slight re-tanning with sumac, which can also be performed in the drum if a suitable paddle for this purpose is not to hand.

For the dyeing of this class of leather, acid and basic dyestuffs are used, although the latter are principally employed on the Continent. When using basic dyes, it is as well to give the skins a preliminary treatment with some mordant, which may consist of tartar emetic, bichromate of potash, or titanium.

The much-favoured custom of clearing the leather in a weak sulphuric acid bath is hardly ever practised on the Continent. For the dyeing of vegetable tanned leather, various methods are applied. The oldest of these methods is the dipping method, which is still carried out very extensively abroad for the dyeing of East Indian goat and sheep skins intended for Morocco leather.

Basic dyes are chiefly employed for this method of dyeing. Although the dipping method is very costly in manual labour it is still used for high-class leather in the fancy leather trade, owing to the flesh remaining practically white. The tray dyeing method, in which packs of skins from one to three dozen are dyed, is almost unknown on the Continent.

Paddle Dyeing

Another method of dyeing small skins, is paddle dyeing. Used originally for dyeing large quantities, it has now lost its importance to a great extent through the introduction of drum dyeing. Paddle dyeing, however, still finds use in dyeing Cape goats for ecrasé work, as with this class of leather the dye liquor must not enter the crevices of the grain. For the dyeing of cheap thin leather, such as basils, skivers, etc., used for lining purposes, the paddle still finds employment. A properly constructed paddle should be provided with a perforated false bottom to allow steam to be infused whilst the goods are in motion, thus keeping the dye liquor at an even temperature.

The paddle should always be charged with the skins well opened out, before the previously dissolved dyestuff is added. To prevent uneven dyeing, a long perforated feeding box should be fitted into the front part of the paddle.

Drum Dyeing

This comparatively new method of dyeing has found great favour owing to its economy in labour and dyestuff in leather dyeing. For looser grained leather, however, it has the disadvantage of working up the dirt in the inner part of the skin by the rotary movement of the drum, which is very detrimental to the subsequent glazing. When dyeing large quantities of dark colours and blacks on sheep, goats, and kips, the drum renders excellent service.

For the production of light fancy shades, Neolan Colours may be successfully applied, either in the drum or by the dip dyeing method. Experience has proved that these colours yield best results when the goods have been previously treated with a weak solution, 2 oz. per dozen medium-sized skins, of chrome alum. The skins are first dyed in a neutral bath, and formic acid is added at the end of the dyeing process.

Dyestuffs Licenses for May

THE following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during May, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—The total number of applications received during the month was 588, of which 480 were from merchants or importers. To these should be added 7 cases outstanding on April 30, making a total for the month of 595. These were dealt with as follows:—Granted, 552 (of which 542 were dealt with within 7 days of receipt); referred to British makers of similar products, 31 (of which 25 were dealt with within 7 days of receipt); outstanding on May 31, 12. Of the total of 595 applications received, 567 or 95 per cent. were dealt with within 7 days of receipt.

Dyeing Celanese in the Presence of Other Fibres

Methods of Dyeing, Printing, De-sizing, and Wetting-out

The following notes are taken from a paper read by Mr. T. B. Meisenheimer, of the Celanese Corporation of America, before the Dyers', Bleachers', Mercerisers' and Finishers' Division of the Southern Textile Association of America. In accordance with American practice Mr. Meisenheimer uses the term "rayon" for regenerated cellulose artificial silks.

CELANESE differs from other synthetic fibres or so-called rayons (artificial silks) chemically in that Celanese is an ester of cellulose and acetic acid, whereas the rayons are regenerated cellulose. This chemical difference causes Celanese to have an entirely different affinity for dyestuffs from any other textile fibre. For this reason various dyestuff firms have developed new groups of colours for dyeing Celanese. One group, known as dispersion colours, is made from some of the same bases as vat colours. Therefore, when dyed on Celanese, these colours are as fast to light, washing, and uric acid, as the well-known vat colours are on cotton.

Manufacture of Dispersion Colours

In the process of manufacturing dispersion colours the anthraquinone or vat bases are passed through a colloidal mill and are dispersed with sulpho-ricinoleic acid, from which method the SRA colours, one of the well-known dispersion groups, receive their name. The dispersion colours dye Celanese direct; in fact, they dye very similarly to direct colours on cotton. However, the dispersion colours require no catalytic agents, such as salts or acids for exhaustion.

Woven goods made entirely of Celanese are generally dyed on a jog dyeing machine. However, in some finishing plants the voiles are being dyed in open vats by fastening one selvage, with strings, to poles which rest across the top of the vat, the other selvage hanging at the bottom of the vat. Thus the fabric is laced in the vat and is agitated as desired by moving the poles backward and forward on the sides of the vat, very similarly to the manner in which poles used for skein dyeing are moved by sliding backward and forward.

Printing with Vat Colours

Fabrics made entirely of Celanese are also printed in designs by the general method of engraved rolls, using printing pastes made from vat colours. Printing pastes are also made from dispersion colours, but owing to the oily nature of these last-mentioned colours it is impossible to get clean edges on the figures in some designs. Considerable progress has also been made during the past year in the discharge printing of Celanese fabrics. This has been achieved by the development of a series of colours suitable for dyeing Celanese which are dischargeable with different reagents.

Cross Dyeing

Since Celanese has a different affinity for dyestuffs from the other textile fibre, it is possible to dye real silk, wool, linen, rayon, or cotton with the various groups of dyestuffs in the presence of Celanese, leaving the Celanese white, or cross-dyeing it any contrasting colour desired. However, to leave the Celanese white, it is necessary to select from the various groups of dyestuffs the proper colours to be used on the other fibres. That is, if direct colours are used for dyeing rayon or cotton, then select the pure direct colours that are not shaded with basic colours, as some of the basic colours stain Celanese heavily. Although the basic colours are not considered fast enough for Celanese piece goods, these colours are sometimes used for cross-dyeing fancy hosiery where the fastness of the colour is considered satisfactory to washing. For cross-dyeing real silk or wool it is also necessary to select acid colours which leave Celanese unstained.

Rayon or cotton can also be dyed with selected sulphur colours in the presence of Celanese. However, in order to do this it is necessary to use as little sodium sulphide and soda ash as possible, keeping the temperature of the dye bath around 100 deg. Fahr., or using animal glue in the dye bath if temperatures are run as high as 185 deg. F.

Wetting-out and De-sizing Celanese

At this point mention may be made of the methods used for wetting-out and de-sizing all-Celanese and Celanese-mixed fabrics before dyeing. The sizing used for Celanese yarn is easily removed by running the goods at 180 to 185 deg.

Fahr. in a bath made up with neutral soap and sulphonated castor oil, and this method is used for goods having Celanese warps. Celanese-mixed fabrics having rayon or cotton warps should be de-sized with an animal or vegetable diastase. However, if these warps are lightly sized, the soap-and-sulphonated-castor-oil wetting-out bath, as suggested for fabrics having Celanese warps, will be sufficient.

Celanese, like real silk, will not stand strong alkalis at high temperatures. However, it is possible to mercerise cotton piece goods that have been decorated with Celanese without injuring the latter. This can be done by not allowing the mercerisation bath to go higher than 59 deg. Fahr.

Methods for dyeing vat colours on rayon or cotton in the presence of Celanese were first developed by eliminating caustic soda and using sodium salts for reduction agents, such as sodium phenolate, sodium beta-naphtholate, etc. However, methods have now been developed whereby reduced quantities of caustic soda are used to obtain satisfactory reduction of vat colours.

Celanese has also been used extensively in the knitting of men's fancy hosiery to obtain two and three colour effects by cross-dyeing with other fibres.

Problems for the Dyer

This particular line of manufacturing has developed some interesting problems from the dyer's standpoint. The colours recommended for Celanese are supposed to be dissolved in a boiling soap solution, and the dyeing carried out in a soap bath. A great many of the hosiery mills in the South (U.S.) are located in sections that have hard water. As some of these mills are small, they do not have expensively equipped dyehouses having water softeners, etc. Therefore, the method of dissolving Celanese colours and dyeing in a soap bath was impossible for those mills, as the soap caused the dyestuffs to be precipitated on the goods in spots, resulting in a condition that made it almost impossible to salvage the goods. This trouble was overcome by substituting a soap made from sulphonated castor oil and soda ash, which does not precipitate under hard water conditions.

The fancy hosiery business has constantly been developing towards more elaborate designs. This has resulted in the rapid development of fancy and complicated knitting machines that require yarns to be more flexible and under perfect control at all times.

Static Trouble in Knitting Hosiery

Owing to the fact that Celanese and rayon yarns have a tendency to take up static electricity generated by belting, etc., this condition, unless it is eliminated, causes considerable trouble in knitting certain fancy designs. It has been found that by treating the Celanese and rayon yarns with conditioning oils, this treatment shunts or grounds static electricity and also makes the yarns much more pliable when knitting.

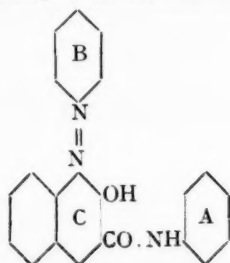
This oil conditioning of yarns and the use of fancy knitting machines which require the use of excessive quantities of lubricating oil, resulting in mineral oil spots on the goods, developed another serious problem in the cross-dyeing of Celanese-decorated hosiery. It happens that any kind of oil on wool, rayon, or cotton acts as a mordant for Celanese colours. Therefore, unless wool grease, conditioning oils, and lubricating oils are removed from the goods before the Celanese colours are added to the dye bath, then very undesirable results are obtained. This trouble has been entirely overcome, and perfect cross-dyed effects are being obtained on fancy hosiery by formulae that require no more time than those used for ordinary dyeing methods. The methods used are to eliminate the oils from the goods during the first thirty minutes of dyeing by dyeing the rayon and cotton yarns in a soap bath, then salting and adding the Celanese colours to the same dye bath during the last thirty minutes of dyeing. Where hard water is encountered, sulphonated castor oil and soda ash are substituted for soap.

Dyes and Their Application: Recent Technical Progress

By L. J. Hooley

Developed Azo Dyes

THE success of the Naphthol AS series among the developed azo dyes has naturally encouraged further investigation in this field, and, as is usual with azo dyes, a large number of intermediates have been proposed either as substitutes for or improvements on the existing ones. Generally speaking, they are more complex than the earlier ones. In those of the AS type the structure may be divided into three parts.



A is the amine used in forming the arylide, B the coupling base and C the naphthol nucleus. New variations are concerned principally with A and B, especially the latter. As regards C, there is no doubt that β -oxynaphthoic acid is the most suitable substance and is the one generally chosen. Some of the new products recently described will be mentioned.

Chlor- and Methyl-Substituted Bases

Colour bases containing chlor- and methyl- groups are already included among the Naphthol AS bases on the market: Fast Scarlet TR base is 5-chlor-2-aminotoluene, Fast Red KB base is 4-chlor-2-aminotoluene, Fast Red 3GL base is 2-nitro-4-chlor-aniline, and Fast Scarlet G base is 4-nitro-2-aminotoluene. These contain either one or two of these substituents, but in recent patents much more heavily loaded aryl bodies are protected, e.g.:

- 2:3 Dichlor 4-amino toluene
- 2:5 Dichlor 4-amino toluene, B.P. 287908.
- 1-Amino 2:4-dichlor 3-methyl benzene.
- 1-Amino 4:5 dichlor 3-methyl benzene.
- 1-Amino 4:6-dichlor 3-methyl benzene, B.P. 287479.
- 1:3-Dimethyl 4-amino 6-chlor benzene.
- 1:3-Dimethyl 4-amino 6-brom benzene.
- 1:3-Dimethyl 4-amino 2:6-dichlor benzene, B.P. 294128.
- 1:3-Dimethyl 4-amino 2-chlor benzene.
- 1:3:6-Trimethyl 4-amino 2-chlor benzene, B.P. 275613 (addition to 274,128).
- 4:4'-Dichlor-6-amino-3:3'-dimethyl diphenyl, G.P. 430579.
- Tribromo-4-aminodiphenylamine B.P. 286274.

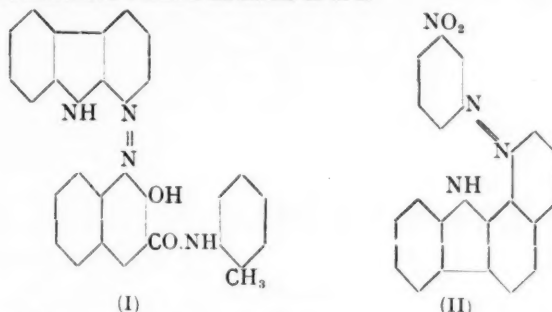
The arylido group in the oxynaphthoic arylide with which these are coupled may also contain halogen and alkyl groups. All the above are patents taken out by the I.G.F.A.-G. The products obtained in coupling are, as would be expected, reds and scarlets. Very vivid shades are obtained in some cases and excellent fastness to light, kier boiling and bleaching is claimed. The use of these amines containing three or four methyl or halogen groups recalls the success which has attended the application of similar products in the synthesis of indigo and thioindigo dyes. A similar tendency also appears to be evident in the azo-pyrazolone dyes in B.P. 276353 (I.G.F.A.-G.), where diazotised 2:5:6-trichlor-3-aminotoluene-4-sulphonic acid is coupled with a substituted 1-sulphophenyl-5-pyrazolone. The products, which are, of course, yellow, are fast to light.

The methods of production of such of these substituted amines as are new are to be found in some cases incorporated in the patents concerned, and also in B.P. 278761, where the starting point is 4-nitro-*m*-xylene.

Carbazole Constituents

In B.P. 282682, B.P. 275326 and F.P. 617211, all taken out by the I.G.F.A.-G., carbazole derivatives are utilised. In the first they act as bases, being diazotised and coupled with the hydroxy-naphthoic arylides, but in the second and third they take the place of the naphthol and are developed

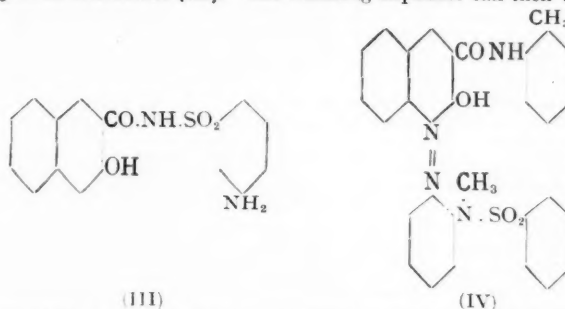
by the better known substituted aniline bases. Thus the *o*-toluidide of 2:3-oxynaphthoic acid is developed in a solution of diazotised 1-amino-carbazole as in I.



Other aminocarbazoles specified are the 2-, 3- and 4-amino carbazoles and 2-amino-3:6-dichlor carbazole, the shades obtained being violet. As naphthols, the 2-hydroxy- α -naphthacarbazole, 2-hydroxy-9-methyl- α -naphthacarbazole and dinaphthacarbazoles are given, these being prepared by the Bucherer reaction from aryl-hydrazines and naphthol- or naphthylamine-sulphonic acids. Coupled with bases such as *m*-nitraniline (as in II), they give brown, brown-violet and violet-black shades. They are fast to light, bleaching and kier boiling.

Sulphonamido Derivatives

As in the case of the carbazole intermediates mentioned above, the sulphonamido constituent is found both in the base and in the naphthol. Examples of the latter are to be seen in B.P. 281795 (B.D.C., Payman, J. B., and Wignall, H.), these being prepared as in the case of aniline-*m*-sulphonamide and 2:3-oxynaphthoic acid, which are condensed by phosphorus trichloride (III). The resulting naphthol can then be



coupled with a suitable constituent. Bases containing sulphonamido constituents are seen in B.P. 255072 and B.P. 279146, both of the I.G.F.A.-G., the dyestuff IV being a scarlet red.

Naphthols as Mordants for Basic Dyes

The naphthols differ considerably in their substantivity for cotton, from the ordinary unsubstituted α - and β -naphthol to the very complex arylido derivatives, some of the latter functioning as colourless dyestuffs or more accurately pale yellow ones. It has now been found that they can be used as mordants for the fixation of basic dyes on cotton (G.P. 441326, I.G.F.A.-G., Guenther, A., Haller, J., and Kiester, E.); the β -naphthylamide of 2:3-hydroxy naphthoic acid and the β -naphthylamide of the corresponding 1:2 acid are mentioned as suitable for this purpose. The dyes obtained do not require after-treatment with tartar emetic, and have the advantages of giving deeper shades with better exhaustion.

Some varied points of interest in connection with these insoluble colours can be mentioned. When they are required as pigments, a fine state of division is produced or maintained by means of alkyl celluloses. These may be added during the coupling stage or incorporated afterwards (B.P. 269918, I.G.F.A.-G.).

Although these colours are of primary interest as insoluble

substances, it is, of course, possible to produce corresponding soluble ones, as, for example, those containing sulphonic acid groups in the arylidionaphthol nucleus, and for special purposes these preserve some of the characteristic advantages of the normal insoluble ones (B.P. 263164, I.G.F.A.-G.).

An alternative naphthol to the 2:3-hydroxy naphthoic arylides is found in the corresponding 2:6 derivatives, produced from 2-naphthol 6-carboxylic acid (F.P. 601709).

Synthesis of Naphthols

The normal method of synthesising the arylides consists of condensing the chloride of the β -oxynaphthoic acid with

the amine. The acid chloride is prepared by British Synthetics, Ltd., and E. B. Higgins (B.P. 278463) by grinding the monosodium salt in a ball mill with the theoretical quantity of thionyl chloride. Grinding for 10 mins. at a temperature of about 60° C. is stated to give a theoretical yield of the carboxylic acid chloride. Instead of using the acid chloride to effect condensation with the amine, the amine is heated with the carboxylic acid, this being done in a tertiary base with phosphorus trichloride. Variations in working detail in the synthesis of the arylamides have also been patented by British Synthetics, Ltd. and E. B. Higgins in B.P. 268877 and 271146.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

IN the Manchester area, trade in dyestuffs during May has fallen off a little, even if the local tendency to make of Whitsuntide a general holiday be discounted. Possibly the holiday, plus threatened labour trouble in the dyeing, calico printing, and allied trades, plus the more deep-seated difficulties in the American cotton spinning section, accounts for the falling off, but it is very difficult to gauge an industry which is so largely engaged in export to such a wide variety of markets.

The first annual shareholders' meeting of Imperial Chemical Industries, Ltd., was an item of special interest to those interested in dyestuffs. It would appear that the first year's results are well up to the most sanguine anticipation and that the company's attempt to place the relationship between labour and capital on a more enlightened footing is achieving the success it deserves. It would not appear that the much-talked-of negotiations with the I.G. have made any serious progress in the matter of dyestuffs, if, in fact, anything has taken place which might be described as negotiations.

During the month Mr. W. J. U. Woolcock's successor, Mr. Davidson Pratt, has taken up his duties in connection with the manufacturers' side of the matters dealt with by the Dyestuffs Advisory Licensing Committee, and although it is probably true that the major cases have been disposed of, yet dyestuffs are of such importance to the consumer that he will probably find an early occasion for the use of the powers which he undoubtedly possesses.

The wages dispute in the dyeing, calico printing, and allied trades is rather unfortunate, and the points at issue have been at issue so long that little credit is due to the members of the conference representing employers and the Trades' Unions if the threatened stoppage takes place in June.

No great progress has been made with the difficulties in the American section of the spinning trade. During the month a ballot taken on the proposal that wages should be reduced showed that insufficient members of the spinners' federation were in favour of it, and no action is therefore possible. The Balfour report on the cotton industry has not been received with great favour, inasmuch as it lacks any clear lead as to the means to be adopted for bringing about a fundamental change in the present conditions.

Yorkshire

THE volume of trade in May as indicated by turnover was distinctly bigger than that of April, but no great improvement on that in May of last year, but as prices generally are considerably lower this year, quantities of material must have increased substantially. The report of the Yorkshire Dyeware and Chemical Co. of Leeds for the year ending March 31, 1928, shows a profit of £23,102, as against £11,737 for the preceding 12 months! With the sum of £1,228 brought in, there is a total of £24,330, as against £17,332. Debenture interest requires £4,104 and the interim dividend £3,000, leaving £17,226. The directors recommend a final dividend at the rate of 12½ per cent., making 15 per cent. for the year, less tax. Ten per cent. was paid for each of the two previous years, and 15 per cent. for 1924 and 1925. There remains £2,226 to be carried forward.

The conditions in the Huddersfield cloth trade are far from

favourable. Indeed, some Colne Valley manufacturers of woollens report them to be as bad as at any time since the slump that immediately succeeded the period of fictitious prosperity following the close of the war. The slackest mills are those specialising in low woollens, for which there is now practically no demand, even though the cloths are offered at extremely low prices. The woollen trade generally is experiencing an anxious time. In the worsted trade one finds a little optimism, and orders for next spring are expected to materialise very soon.

The Heavy Woollen district remains fairly brisk, and some firms have business on hand that will keep them employed for a considerable time. Production is chiefly for export, the Canadian market especially affording large orders for heavy winter wear. The demand in men's cloths for the home trade is mainly for blues, browns, greys and blue-greys, all of a quieter order; in women's wear the demand is for light hues.

The Australian market for woollen and worsted cloths has been killed by the high tariffs, and an unfavourable opinion regarding the sentiments of the Australian Commonwealth exists to-day in the Huddersfield and Dewsbury districts, not only on account of the tariffs, but also on account of the suddenness of their application. The duties passed the House of Representatives, came into force the following day, and received final assent three days later; and no allowance was made for goods afloat, or for orders given prior to the new duties coming into operation. The trade here feels the action of Australia to be a poor return for the good custom she derives from it in the shape of huge wool sales. It is interested to observe how long the Commonwealth, with its small population, will be able to afford to protect its secondary industries.

A rumour gained currency here of a likelihood of an agreement between Lister and Co., Ltd., of Bradford, and J. and P. Coats, Ltd. The market view is that negotiations aiming at a control of Listers by Coats have been carried on for some time, and that the occasional drops in the prices of Listers' shares have been due to temporary hitches.

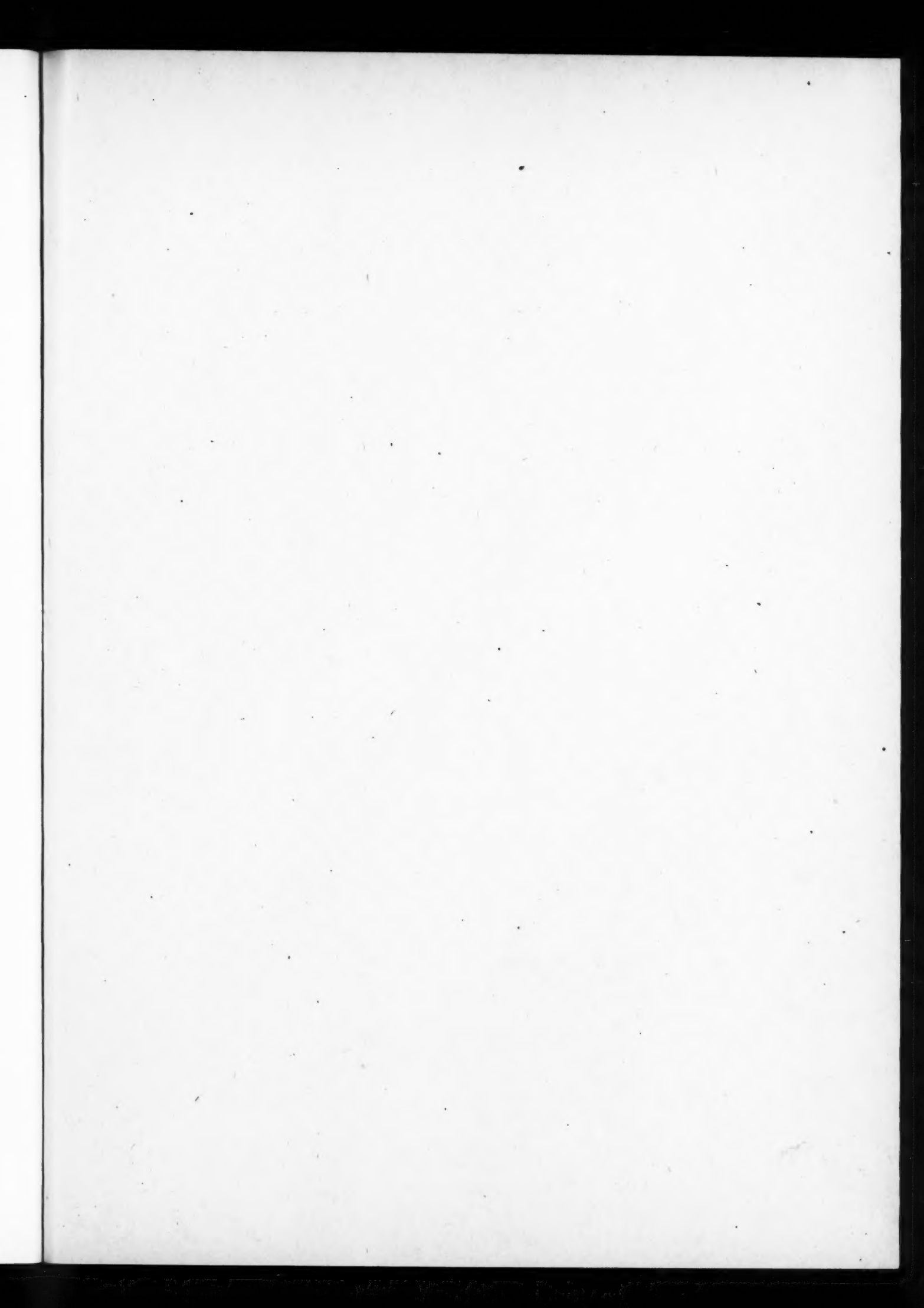
Scotland

Business in Scotland has been fairly good on the whole during the past month. There has been greater activity in dyeing and printing in and around the Glasgow district, and the bigger firms especially are reporting increased business.

The dyeing and cleaning firms, of which there are several important ones in Scotland, are also having a fairly successful time.

A settlement has not been reached yet in the outstanding wages question. The meeting of the Federation of the Scottish Dyers and Bleachers, which was held in Glasgow last month, is to be followed by another one during June.

The wool trade continues satisfactory, most manufacturers being occupied at present on the winter orders, while the new patterns for spring, 1929, have been well received. Wool prices still remain high and there is no immediate likelihood of any reduction. The foreign demand and the absence of the finer woollens are held to be responsible for this. Considerable activity is also reported in the knitting trade.





Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

213/3/88



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Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

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The Present Development of Corrosion-Resistant Alloys (From a Correspondent)

This article appears at a very opportune moment, and should be of great interest to metallurgists. The importance of the investigation of means of combating corrosion has repeatedly been stressed, and it is certain that one of the best lines of advance is in the production of corrosion-resisting alloys.

THE importance of the subject of corrosion in metals is now recognised to such an extent that the scientific study of the principles underlying corrosion phenomena, and the development of methods of preventing corrosion by modifying the composition of known alloys and introducing new ones and by devising methods of protection for ordinary commercial alloys, has constituted one of the chief features of metallurgical research work of recent years. Much excellent work on the elucidation of the principles governing corrosive action has been carried out in this country, and results have been obtained which in importance and usefulness justify the belief that in this direction we are not lagging behind investigators elsewhere. Methods of protecting metals have also received considerable attention, and success has attended the efforts made to protect aluminium and its light alloys by the anodic oxidation process, but this is yet in its infancy. While the biggest developments in protection by deposition of chromium have been made in America, this country has had its share in the development of corrosion-resistant alloys, especially ferrous alloys.

Growing Demand

It is not surprising that the study of the corrosion problem should be pursued with such notable zeal, since considerable demands for materials of a metallic nature capable of withstanding attack by acids and chemicals of various kinds, atmospheric influences, sea water, and heat are now being made, the chemical industry in particular having many needs to meet, and with the rapid development in many of its branches new requirements have to be satisfied.

It would be impossible to catalogue the various applications, actual and possible, of corrosion-resistant alloys of different kinds for different purposes. In some form or other they seem to be needed everywhere. In some instances it is but a question of appearance, the need for a permanent brightness and polish without the trouble of repeated cleaning, while in others it is the need for material to resist attack or progressive corrosion when in contact with some particular chemical substance or when exposed to certain corrosive influences. To a large extent the conception of non-corrodible alloys has become associated with the idea of a metal possessing a highly polished and lustrous exterior. This is an unfortunate misconception, for in many applications of corrosion-resistant alloys a highly finished surface is not a necessity provided the material is resistant to progressive corrosion under the particular conditions of service. The extended use of the alloys probably lies more in this direction than in those applications where a polished finish is necessary, and especially is this likely to be so with ferrous alloys of the so-called stainless iron type. It is possible to conceive of the use of this kind of material on an extended scale, now that it is being made more cheaply and in much greater bulk than formerly, for structural purposes where a fine finish would not be necessary and scarcely possible from an economic standpoint. The material would nevertheless be satisfactory and permanent in resisting progressive corrosion and decay through rusting.

Corrosion-Resisting Coatings

On the other hand there are many applications, often in the case of small articles, where surface finish is of equal importance to corrosion-resisting properties. For the sake of

cheapness it sometimes suffices to use a common metal and protect it from corroding by coating it with some resistant material, and where conditions permit it, paints, lacquers, or varnishes are often used. So far as obtaining protection by the use of metal coatings is concerned, most success has been obtained by electro-deposited chromium. While superficial protection may be adequate in many cases, it is quite insufficient in others, and without disputing the great utility and future scope of this form of protection, there are advantages in having corrosion-resisting properties inherent in the metal itself, rather than in thin coatings which can wear away, or which in parts may occasionally peel off or exhibit defects and cease to afford protection, and may even set up localised corrosion of a pronounced and highly injurious nature. The electro-deposition of such metals as nickel and chromium has so far been generally confined to relatively small articles, attempts at protecting large areas such as sheet by coating with other metals having taken the form of tinning or zincing by dipping or other processes.

While quite a wide range of corrosion-resistant alloys are now known and made, no single alloy is known which is resistant to all materials, but there are alloys actually marketed which resist a wide range of corrosive influences and others which, though perhaps more limited, are highly resistant to particular substances or influences. The whole field is not yet covered, but in due time it will no doubt be possible to have a number of alloys each of which is resistant to different materials and useful in some particular application. The available alloys will doubtless be greatly increased in number so that in the not far distant future it may be possible, in seeking for a material for a given purpose, to have several alloys to choose from, of similar corrosion-resisting properties but possessing variations in other properties, thus making it possible to meet requirements more completely and satisfactorily than can be done in some instances at present.

Some pure metals, notably gold and platinum, possess a low affinity for oxygen and are excellent corrosion-resisting materials, but their cost precludes their use in any but very special and limited applications. Here the property of resistance to corrosion is inherent in the metal itself. Most of the more ordinary metals combine readily with oxygen, but in some cases a surface film of oxide is formed which retards further corrosion and protects the metal more or less completely against certain influences if the film is both continuous and closely adherent. Many alloys are made corrosion-resistant in this way by the addition of metals which give rise to a protective oxide film, chromium being an outstanding example.

Value of Solid-Solution Alloys

Some interesting observations on the nature of alloys and their corrosion-resisting properties are included in a recent paper by W. M. Mitchell (*Ind. Eng. Chem.*, 1927, Vol. 19, 1253), who states that as a class, alloys which consist wholly of a solid solution, as well as possessing better mechanical properties, show superiority in their resistance to chemical attack over alloys which contain more than one constituent. In a pure metal it is the "unsatisfied affinity" of the atoms for those of other substances which determines its readiness of combination. This unsatisfied affinity may be reduced by the addition of other elements to form solid solutions. Still

further reduction of the affinity by the addition of another metal entering into solid solution further increases the resistance to chemical attack. Thus the resistance of iron to oxidation is improved by the addition of chromium, while the addition of a second metal, nickel or silicon, increases the resistance to oxidation at higher temperatures and also renders the alloy resistant to other influences.

Many intermetallic compounds are even more resistant to attack than solid solutions, because of their chemical stability, but their physical properties are usually such that possible industrial applications are very limited. In general, the resistance to corrosion of a metal or alloy is determined primarily by its resistance to other elements, especially oxygen, sulphur and the halogens, and the manner this affinity is affected by the addition of other metals. The addition of silicon to a metal resistant to acids, increases that resistance, and the addition of chromium similarly increases resistance to oxidation.

Classification of Alloys

Corrosion-resistant alloys are divided roughly into groups according to the outstanding property of the base metal or the chief alloying metal. Amongst them are the iron-chromium, iron-silicon, iron-chromium-nickel, copper-base, nickel-base and aluminium alloys. The possible production afforded by oxide films has already been indicated, and zinc, aluminium, lead, nickel and copper form oxide coatings in air which prevent further attack. Where resistance to influences other than atmospheric is needed the usefulness of the coatings formed, in preventing further attack, depends on the solubility of the salts formed by the material with which the metal is in contact. Lead sulphate, which is formed when the metal is in contact with sulphuric acid, protects it from further attack, but when the acid is above a certain concentration the sulphate is dissolved and the lead is no longer immune.

One of the groups of alloys developed earliest with the object of providing a material resistant to many corrosive influences is the iron-chromium group, which originated in this country about fourteen years ago. The original alloys, stainless steel, contained about 0.3-0.4 per cent. of carbon in addition to 11 to 13 per cent. of chromium, and were only stainless after heat treatment, which was necessary to put the carbides into solid solution. With the advent of a very low carbon ferrochrome it became possible to manufacture a similar alloy in which the carbon content was low—usually less than 0.21 per cent.—so that carbides were more or less absent and the alloy was resistant to corrosion without any heat treatment. Furthermore the alloy—usually known now as stainless iron—is tough and strong, and can be used where it is not possible to employ stainless steel.

Stainless Steels and Irons

W. M. Mitchell, in a recent publication (*Ind. Eng. Chem.*, 1927, Vol. 19, 1171) gives some useful information on the properties of various stainless steels and irons and of their application in chemical plant construction. In addition to the two foregoing types of alloy, he includes three others in this group, namely: those with over 16 per cent. chromium and under 0.10 per cent. carbon, which, because they possess very little hardening capacity, are more nearly true stainless irons; the iron-chromium-nickel alloys, the composition of which varies within very wide limits; and the high-chromium alloys, which contain 20 per cent. or more of chromium with medium or high carbon and without the addition of appreciable amounts of other elements. The physical properties of these alloys are now fairly familiar and generally known. Stainless steel has been used for valve seats and the wearing parts of grinding and crushing machinery, in addition to cutlery. Mild stainless steel has been made in many different forms, such as plates, nuts, bolts, bars, and sheet, and is used in the construction of retorts and autoclaves and for valve fittings, turbine blading, stems, pump rods and plungers. It resists oxidation indefinitely up to 800-825°C. The stainless irons are also very widely used in the construction of chemical plant, and many alloys of this type are made under trade names, such as Ascoloy, Carpaloy, Unaloy, Enduro, Delhi, etc.

Chromium as an Alloying Metal

The presence of chromium imparts remarkable resistance to the action of nitric acid and oxidising influences, and the alloys find ready application in nitric acid plant, in oil refinery

equipment, etc. The iron-chromium-nickel alloys possess the advantages of stainless iron and other advantages in addition. The alloy Staybrite, which is made in this country, and Super-Ascoloy, which is made in America, are in this class. The alloy is homogeneous, being austenitic in character, and is not hardened by heat treatment. The chromium content varies between 7 and 20 per cent., and the nickel content varies similarly, but a low nickel usually accompanies a high chromium and *vice-versa*. The presence of nickel improves the general corrosion-resisting properties without impairing the resistance to nitric acid and sulphur compounds, providing the chromium content is sufficiently high. The alloy welds readily and the welds remain ductile. It is also resistant to several acids which attack ordinary stainless steel. The special application of alloys containing over 20 per cent. of chromium is where resistance to oxidation at elevated temperatures is required. The usual alloys contain 25 to 30 per cent. chromium, and withstand temperatures of 1150°C., for long periods.

An alloy of cobalt known as Stellite, which contains 40-50 per cent. cobalt, 15-33 per cent. chromium and 5 to 25 per cent. tungsten, and may also contain nickel and molybdenum, possesses useful mechanical and corrosion-resisting properties, and it has been used for surgical instruments and the wearing parts of dies because of its great resistance to abrasion.

Nickel and its Alloys

Because of its high resistance to caustic alkalis at all temperatures and concentrations, nickel and some of its alloys have long been known and used for their corrosion-resisting properties in certain circumstances, and have been widely employed in the dairy industries. Monel metal—an alloy made directly from copper-nickel ore—possesses very useful mechanical properties in addition to being resistant to certain types of corrosive influences, and has found application in the manufacture of pickling equipment because of its resistance to dilute sulphuric acid. Copper-nickel alloys are, of course, also made synthetically, and Corronil, which contains about 26 per cent. of copper and 4 per cent. of manganese is well known. Some of the alloys of copper and nickel, where the latter can be regarded as an addition, are considered below under copper alloys. Alloys of nickel and chromium are very resistant to oxidation and are used as electric heating elements, annealing pans, cover stems for pyrometers, etc. Nichrome, Brightway, Glowray, and Kromore are in this class, while Cochrome is an alloy similar to nichrome but containing cobalt instead of nickel. The alloys of nickel and chromium frequently contain varying amounts of iron which cheapens the cost but renders working more difficult.

According to Bassett (*Chem. Met. Eng.* 1926, Vol. 33, 618) tubes of deoxidised copper are more resistant to corrosion and possess superior mechanical properties to ordinary copper tubes, and are used extensively in heaters, coolers, and condensers in many kinds of plant. Ordinary copper alloys are not resistant to the simultaneous action of strongly oxidising and acid conditions. Aluminium bronzes containing 6 to 10 per cent. of aluminium and 1 to 5 per cent. of iron are highly resistant to several dilute acids, alkali solutions and a wide range of organic acids. Such alloys are Ampco, Alcumite, and Resistac, and they are used for pump parts and pickling equipment. The figures in Table 1, from Bassett's paper, indicates the mechanical properties of the straight aluminium bronzes in the form of rods.

TABLE No. 1.
PHYSICAL PROPERTIES OF ALUMINIUM BRONZES.

Aluminium Per cent.	Tensile Strength Hard.	Tons/ Sq. In.	Elongation Hard (on 10 in.)	Per Cent. Soft (on 2 in.)
5	30.8	23.6	12	55
8	37.0	26.8	20	61
10	42.9	35.7	5	33
1 on 10 in. 2 on 2 in.				

Various Copper Alloys

Many attempts have been made to improve the corrosion-resisting properties of copper and copper alloys by the addition of nickel or the substitution of it in place of some of the zinc and tin in the brasses and bronzes. Aterite, Davis metal, Mecco, Ambrac and Everbrite are alloys of this kind. Everbrite contains 70 per cent. of copper and 30 per cent. of nickel; Ambrac contains 20 per cent. of nickel and 5 per cent. of

zinc; and Meco is lower in copper and contains 25 per cent. of nickel, 20 per cent. of zinc, and 5 per cent. of other elements. Aterite is a copper-nickel-iron alloy of variable composition frequently containing zinc, and contains 30 to 60 per cent. of copper, 10 to 40 per cent. of nickel, and 5 to 10 per cent. of iron. In Davis metal, which is of a similar composition, the iron content is somewhat lower and a small percentage of manganese is present. Adnic is an alloy containing 70 per cent. of copper, 29 per cent. of nickel and 1 per cent. of tin. As a class these copper alloys are resistant to dilute sulphuric and hydrochloric acids, caustic alkali and salt solutions, fatty acids, etc. Since they are of a white colour they are also used for ornamental purposes and domestic fixtures.

According to Bassett, Ambrac was made to meet the demand for a nickel-coloured alloy which possessed a high resistance to corrosion and tarnishing, and which could be readily worked. It is used in exposure to salt solutions or spray, alkaline solutions, etc., and in the form of tubes has been used successfully in salt evaporators and in the manufacture of caustic soda. It is immune from season-cracking. Everdur is another very interesting copper alloy, and contains 95 per cent. of copper, 4 per cent. of silicon, and 1 per cent. of manganese. It was developed originally to resist corrosion by hydrochloric acid, and has been found to be of service in many other directions, but like the other copper alloys it is not resistant to strongly oxidising influences. The alloy possesses excellent mechanical properties and in addition to being readily workable casts well in green sand. Adnic, according to Price (*Min. Met.* 1927, Vol. 8, 474), was developed, in the first place, to meet the demand for a suitable diaphragm material. It possesses good mechanical and corrosion-resisting properties, retains its strength well at elevated temperatures, and it is not susceptible to season cracking. It can also be readily worked both hot and cold. Some of the mechanical properties of Everdur and Adnic from the papers of Bassett and Price are given in Tables No. 2 and 3.

TABLE NO. II.—PHYSICAL PROPERTIES OF EVERDUR.

	Yield Point Tons/ Sq. In.	Tensile Strength Tons/ Sq. In.	Elongation Per cent. on 2 in.	Reduction of Area Per cent.
Green sand castings ..	13.4	22.3	24	35
Hot-rolled Rods	21.4	33	56	53
Rolled sheets, half hard	25	35.7	40	—
Cold-drawn tubing (as drawn)	26.8	43.7	16	—
Cold-drawn tubing (normalised)	22	30.8	42	—

TABLE NO. III.—PHYSICAL PROPERTIES OF ADNIC.

	Yield Point Tons/ Sq. In.	Tensile Strength Tons/ Sq. In.	Elongation Per cent. on 2 in.	Reduction of Area Per cent.
½ in. hard rod	47.7	50.4	10	56
1 in. hot rolled hex. rod	15.9	28.8	46	72

Aluminium alloys, as a class, are not notably resistant to corrosion, although some of them behave comparatively well under certain conditions. Additions of silicon to certain alloys substantially improve their resistance to attack by acids, and high-silicon irons have been developed for the manufacture of plant for acid works.

In recent years, attempts have been made to produce sterling silver possessing tarnish-resisting qualities and one known as Silanca contains 93 per cent. of silver and 4.5 per cent. of antimony, the remainder being cadmium or zinc or both. An investigation has been carried out on the physical properties and tarnish-resisting properties of silver alloys by Jordan, Grenell and Herschman (*Amer. Inst. Min. Met. Eng.*, Advance Proof, March, 1927), who found that alloys of silver with cadmium or zinc were the most tarnish-resistant of the binary alloys, but they possessed the lowest tensile strength of all the workable binary alloys. Antimony and tin strengthen silver and tend to increase the tarnish resistance, but not to the same extent as cadmium or zinc. The addition of antimony or tin to a silver-zinc alloy in amounts which do not reduce the silver content below 92.5 per cent., produces workable alloys with marked resistance to tarnishing. Although none of the alloys tested were altogether non-tarnishing, many were much more resistant to sulphur tarnish tests than ordinary sterling silver.

M. C.

"Pure Iron by Difference"

A Point in the Analysis of Iron and Steel

A CORRESPONDENT writes us as follows:—

An expression which occurs frequently in referring to the chemical analysis of mild steel and wrought iron is "pure iron by difference"—a hypothetical figure obtained by subtracting the total of all the elements determined in the analysis from 100 per cent. The sanction of usage is in this case no excuse for perpetuating an error both fallacious and misleading. The figure quoted as "pure iron" actually includes:—

1. The cumulative errors in weighing and analysis which the chemist has made.
2. The unestimated elements.
3. The percentage of ferrite present containing iron phosphide, iron silicide and manganese in solid solution—making up the bulk of the metal.

"Pure iron" as shown in the manner indicated simply does not exist.

Two typical analyses of mild steel and wrought iron suitable for tubes for example, would be as under:—

	MILD STEEL.	WROUGHT IRON.
Carbon	0.08	0.025
Silicon	0.02	0.18
Sulphur	0.05	0.025
Phosphorus	0.07	0.28
Manganese	0.33	0.08

Total estimated elements	0.55	0.59
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Judged by the criterion of "pure iron by difference" the mild steel would be considered slightly purer than the wrought iron. When, however, the true composition of the two materials is calculated from ordinary metallurgical data, the comparison as shown below takes on a totally different aspect:—

	MILD STEEL.	WROUGHT IRON.
Pearlite (containing 0.95 per cent. carbon	8.42	2.63
Manganese Sulphide	0.14	0.07
Slag (containing 15 per cent. SiO ₂) Ferrite containing phosphorus, manganese, silicon, etc., in solid solution)	nil 91.44	2.56 94.74
	100.00	100.00

The phosphorus shown in the ordinary analysis of wrought iron is, of course, divided between the ferrite and the slag, where it exists as ferric phosphate, included from the puddling operation.

In view of these considerations the purchaser of iron or steel in any form needs to examine more critically the claims of "purity" advanced by the partisans of any particular material, and it is to be hoped that the "pure iron by difference" error will be relegated to the myths where it belongs.—S. J. A.

Staybrite Steel for Exterior Decoration

THE Birmingham Guild, Ltd., of Grosvenor Works, Birmingham, and 28, Berners Street, London, W.1, are making a special point of the use of Staybright steel and Guild vitreous enamel for the purpose of permanent exterior decorations, such as shop fronts; signs, name-plates, and lettering; show-cases, shop-fittings, etc. It is thus possible, in the case of shop-fronts, for example, to have a polished silver effect, beautifully decorated in colour, which is proof against rain and weather, acid-laden atmosphere, sunshine or fog. The frame needs cleaning only in the same way and by the same man who cleans the plate-glass window. The beautiful silver colour of Staybrite steel—it can be used with a high glittering polish or subdued to the tint of old silver, and will keep its colour permanently—renders it very suitable for this purpose.

Merchandise Marks: Enamel Zinc Sheets

The standing committee (general merchandise) appointed by the Board of Trade will hold their inquiry as to whether enamel zinc sheets for covering walls, ceilings, and similar purposes shall bear an indication of origin, at 11.30 a.m. on Monday, January 16. A further meeting will be held at 10.30 a.m. on the next day. The inquiry will be held at the Board of Trade Offices, Great George Street, London, S.W.1. Communications should be addressed to the Secretary, Mr. E. W. Reardon, at that address.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Corrosion and Standard Tests

DR. G. D. BENGOUGH, formerly investigator to the Corrosion Research Committee of the Institute of Metals, is to deliver a lecture on the subject of "Corrosion, with Special Reference to Standard Tests," at a meeting of the London Local Section of the Institute of Metals, to be held in the rooms of the Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, London, S.W.1, on Thursday, January 12, at 7.30 p.m. The lecture should be of great interest, especially at a moment when the question of standard tests for corrosion is receiving much attention. A similar lecture, given recently in Birmingham by Dr. Bengough, was found to be very helpful and suggestive. Visitors are invited to the meeting on January 12, for which tickets can be obtained on application to Mr. W. T. Griffiths, M.Sc., F.I.C., honorary secretary of the London Local Section of the Institute of Metals, c/o The Mond Nickel Co., Ltd., Victoria Station House, Westminster, London, S.W.1.

Research in 1927

A vast amount of research work has been done during the past twelve months. The results which have been published relative to corrosion research have hardly simplified the issues. On the other hand, useful and practical work has been done in the further investigation of the properties and treatment of the light alloys. Interest during the year has centred chiefly in the aluminium-silicon series, the possibilities of which have been more thoroughly explored than most of the other light alloys. In Germany, considerable advance has been made in the metallurgy of magnesium, and this metal is being extensively studied both in France and in America. It is significant that production figures are not available in either of those countries, and a good deal of mystery attaches to the extent to which either magnesium or its alloys is being actually employed in automobile and aeronautical construction. The lack of interest evinced in this country in regard to magnesium is regrettable, and it is still, to all intents and purposes, an unknown metal. Some useful work has been carried on in Germany in regard to beryllium, and the price has fallen to little more than that of silver.

Automobile Metals

The bulk of the new work in metallurgy has been in exploring the properties and improving the production of die castings for the automobile industry, and, as has already been said, chiefly in regard to the light alloys. The heavy alloys, and in particular, the aluminium bronzes have, however, come in for a good deal of attention. There are indications that the British motor industry will eventually extend enormously, and that metallurgical research in the next few years will be largely focussed on its requirements. In the long run, the light alloys will probably be endowed with the properties of strength, hardness and impact resistance in which, broadly speaking, they are deficient as compared with the existing heavier metals and alloys, and will therefore constantly tend to supersede them.

The requirements are dictated by engineering needs, and, especially, by power economy considerations. The lower the overall weight of a car or a lorry the smaller the petrol consumption and, probably, the greater the efficiency; and as this applies to the chassis and the body as well as to the engine, it is up to the metallurgist to comply with the automobile engineer's hopes and aspirations.

Chromium Plating

CONSIDERABLE interest continues to be evinced in chromium plating, and much of the research work done in 1927 on the subject of protective coatings has been directed towards this aspect of the industry. An exceedingly valuable contribution to the literature of the subject has been the "Abstract of Published Patents dealing with the electro deposition of Chromium" published by the Engineering Research Department of the University of Michigan. This report, by R. Schneidewind, contains far more than is implied by its title. It contains comments and critical matter concerning the various patents enumerated which cannot fail to be of immense value to all workers in chromium plating. Once

the problems and difficulties relating to it have been solved, chromium plate will undoubtedly prove of enormous benefit. It is of interest to note that in the opinion of the author of the above-mentioned publication, it is doubtful whether there is any patent or group of patents which can control the process of the electro deposition of metallic chromium from chromium acid baths. It is evident that chromium, after having provided the metallurgist with a host of as yet unsolved problems, will provide the law courts with a fresh batch, which will enable him to recover, in fees as an expert witness, some little of the loss which has hitherto attended the practical application of many of the patents.

On Insufficient Data in Research Work

UNLESS all of the cards are put on the table, the results of a research, however laboriously they may have been obtained by their author, may be robbed of much of their real value to others. Thus the research on the cementation of iron alloys by boron, detailed by M. Joseph Laissus in the October issue of the *Revue de Métallurgie*, loses a good deal in the telling simply because not enough is told. The experiments were made on electrolytic iron, on eutectoid steel, and on grey pig iron, but, except in the case of the electrolytic iron, the composition of which may perhaps be taken for granted, only the carbon of the steels is recorded, and there is no analysis given of the grey iron. Moreover, there is a good deal of vagueness about the composition of the cement. It was a ferroboration containing 0.22 per cent. of carbon and 26.53 per cent. of boron.

The results that emerge must be taken somewhat on trust, for the data given are not sufficient to endow the research with anything like the absolute values which can, and should be, sought for in modern metallurgical investigations. In no operation are variables, and, in particular, variables in respect of composition and the presence of impurities, more influential than in the delicate operation of cementation. All sorts of obscure phenomena of diffusion, catalysis, etc., affect the nature, depth, and physical structure of the ensuing "case."

Cementation by Boron

WE know very little about boron alloys. There are said to be materials on the market which contain this element, but, on analysis, it is apt to prove evasive. However, M. Laissus has succeeded in showing that a quite definite case is obtained when carbon steels are cemented with powdered ferroboration. His results are more suggestive than rigid. The presence of carbon reduces the cementing action by boron; the higher the carbon the thinner the "case." There is, he says, a ternary alloy BCF_e formed. The case seems, in some instances, to scale somewhat readily. The point of most interest is that the cementation of ferrous materials renders them superficially, at least, less susceptible to attack by acids, particularly by hydrochloric acid, while at the same time "boronisation" actually favours rusting, and a boron-cemented specimen rapidly becomes covered with a coating of—presumably—iron rust. Lastly, a boron-cemented specimen resists oxidation at high temperatures (800° C.) better than a non-boron cemented specimen. These are highly anomalous results.

Corrosion and Plating Problems

THE whole question of corrosion tests is very much in the melting pot at present. As for the "accelerated" tests, many firms of the highest repute have long since discarded them—the American Rolling Mill Co. (Armco), for example. It is pretty generally felt that they may mean anything or nothing and have hardly any practical value, except possibly for testing the "resistance to corrosion" of specific alloys required to be subjected to the action of specific acids. This is to make corrosion synonymous with solution, which may suit some chemists, but will not suit all.

The whole question of corrosion and of corrosion testing has become rather academic, that is, it has gone a long way from the practical point of view which merely seeks to enquire how a given material will stand up to given conditions. If we know anything at all it is that failure, when it comes, or

begins, often occurs very suddenly, and that "simulated" time tests may often give the most misleading results. There is, however, a severely practical direction in which a move is about to be made. It is not exactly a matter of corrosion testing, although it involves that too. It is the question of standardising methods of plating, and, in particular, the thickness of electro-deposited coatings.

Standardised Platings

THE body that is about to move in this matter is the Electroplaters' and Depositors' Technical Society. Electro plating has suffered a good deal of late from slovenly work. Nickel plating, in particular, is often scamped, with the result that a splendid, lasting, and decorative mode of preserving a corrodible base, like steel, is falling into disrepute with the general public, because some platers are niggardly with their materials, and careless in their methods. On superficial inspection a new but wholly inadequate plating may pass muster as a good one. The Society feels that the time has come when this and kindred matters should be looked into, in the joint interests of the plater and his customer, so that some sort of guarantee may be forthcoming as to the depth and soundness of the plating. A committee has been formed, and co-operation will be sought with other bodies. Mr. S. Field, of the Northampton Polytechnic, is the President, which, in itself, is something of a guarantee that the committee will take itself seriously. Difficult and prolonged though the task may be, there is no reason why the Electroplaters' and Depositors' Technical Society should not prove capable of seeing it through.

Aluminium Alloys in America

Dr. Z. Jeffries, in a discussion before the New York Electrical Society, exhibited bars of new metal alloys which were claimed to be stiffer and stronger than steel, though composed largely of aluminium. When arranged as miniature cantilever structures like those sometimes used in bridges or skyscrapers, the bar of the new alloy sank only one-seventh as much under a given load as a bar of standard steel of the same weight and width. These new strong alloys contain small quantities of constituents which impart great strength and stiffness as well as other desirable properties. Articles manufactured from the alloys range from aeroplane propellers to thin discs of metal that operate phonographs and loud speakers. Reference was also made to tests in progress with street and railway cars made of the new aluminium alloys which offer means of great savings, due to 30 per cent. less weight, with an average saving of 22 per cent. of the power used for the movement of steel cars.

United Steel Companies: New Managing Director

MR. R. S. HILTON, formerly secretary and general manager of the Birmingham Gas Department, and for the last nine years managing director and deputy chairman of the Metropolitan-Vickers Electrical Co., Ltd., of Trafford Park, Manchester, has accepted the position of sole managing director of the United Steel Companies, Ltd., one of the largest industrial combines in this country.

Platinum in Sierra Leone

THE Colonial Office announce that platinum has been discovered in Sierra Leone. It was first found in May, 1926, by the Director of the Geological Survey, Major N. R. Junner, and a recent investigation by him indicates that the platinum-bearing area is about 40 square miles in extent and that the deposits, which are alluvial, are likely to be of considerable importance. One nugget of platinum weighing 7.4 grms. (4½ dwt.) was found by Major Junner. This nugget and some of the smaller grains of platinum have been presented to the British Museum (Natural History), South Kensington. An analysis made by the Imperial Institute of the platinum shows that it compares very favourably in composition with the platinum from the Urals and from South Africa.

Detailed information regarding the locality of the platinum discoveries will be given to any firm or persons who can satisfy the Sierra Leone Government as to (a) their financial standing, and (b) their bona fide intention and capacity to undertake mining operations in the event of these being likely to prove profitable. The Sierra Leone Government, however, reserves the power to limit the number of prospecting rights issued in respect of this locality.

High Frequency Induction Melting

A GREAT deal of interest was aroused by the demonstration given recently by Edgar Allen and Co., Ltd., of the Imperial Steel Works, Sheffield, of the operation of their Ajax-Northrop high-frequency furnace. This furnace, the first of its kind in the world to be used for the commercial manufacture of high-quality tool steel, deals with a charge of 450 lb., and permits of the production of high-class steel under very strictly controlled conditions, without the slightest danger of contamination by foreign gases. Edgar Allen and Co. have a remarkable record as pioneers, for in 1909 they put down the first Héroult electric furnace installed in this country.

The Manufacture of Crucible Steel

THE same firm has recently issued for private circulation a beautiful illustrated brochure entitled "The Manufacture of Crucible Steel." It opens with an account of the history of crucible cast steel, discovered 200 years ago by Benjamin



ROLLING CRUCIBLE STEEL AT THE WORKS OF
EDGAR ALLEN & CO.

Huntsman, the Doncaster clockmaker. The rest consists of a series of excellent photographs of various phases of the crucible steel process, to each of which is appended an explanatory note. Every aspect of the process, including the making of crucibles, the raw materials, charging, rolling, forging, anneal-



FORGING INGOTS OF CRUCIBLE STEEL AT THE WORKS OF
EDGAR ALLEN & CO.

ing, pickling, etc., is dealt with. The photographs are splendidly reproduced, and the general make-up and arrangement of the volume are a credit to all concerned; the publication will be highly prized by those who have received it. Two of the pictures are shown herewith, dealing with forging and rolling respectively.

Trade, Commerce, Finance : The Month in Review

From Our Northern Correspondent

HAVING entered upon the New Year, it may be interesting to look back over the year which has just closed, and to review the course of the iron and steel industry during that period. It has been a year of varied experiences, ranging through the whole gamut from active full-time operation throughout the industry, to dullness, shortage of work and partial cessation of production. The year opened with an activity in trade such as has not been witnessed since 1921, every steel works being in the unusual position of having more orders than could be dealt with, all the mills working at top speed, and demand exceeding supply. That condition lasted for a few months, then the reaction set in, orders fell off, and by the autumn the works had been reduced to a state of intermittent operation as bad, if not worse, than that which preceded the coal strike. It was, on a miniature scale, a repetition of the conditions which succeeded the close of the war—unexampled activity followed by the severest depression. Similar causes operated in each case and brought about similar results.

To refer to the conditions of trade in the beginning of 1927 as one of feverish activity is an apt description. It was an unhealthy condition, and as such was bound to have evil effects. Its cause was an industrial sore and its ultimate subsidence showed how serious the evil had been. The whole nation was poorer by reason of the stoppage due to the coal strike, and both the coal trade and the iron and steel trade have suffered grievously because of it, notwithstanding the slight advantage gained during the busy months of the first quarter of 1927. The reports of most of the undertakings which have been published during the year have given an arresting picture of the damage done to both industries. Possibly we are on the way to recovery, but the convalescence will be long and slow.

The Last Quarter of 1927

Just as the beginning of the year was marked by exceptional conditions, so the closing quarter belied all previous experience, and instead of providing a little stimulus and an awakening from the quietness which prevailed during the middle months, such as past years had taught one to expect, there was on this occasion no sign of any revival, and trade languished on without hope of relief; and business men shook their heads, and predicted that nothing would be done until the New Year, probably not until the spring.

The past year has also been noteworthy because of the efforts that have been made to re-establish trade in the coal fields and in the iron and steel works. The collieries were very hard hit by the strike, and for some months have been in a wretched condition, passing through a depression as severe as any that has been suffered by the steel trade. Prices have been down at the bottom and orders so scarce that the output was very materially reduced and costs of production correspondingly increased. So much ground was lost both at home and abroad, that it will take a long time to recover it, if ever that is done completely. The opening in the export market made by the coal strike here was taken full advantage of by other exporting nations, and they will not easily be ousted.

Restriction of Output of Coal

At home, the necessity of finding substitutes for coal during the time when supplies were unavailable has taught many of the smaller users, particularly householders, how to manage without it. The result has been a large decline in the volume of home trade for house coal, which, coupled with the loss of the export trade and the falling off in the demand for industrial purposes, has brought the coal trade face to face with as serious a crisis as any which has previously confronted it. To meet this, a scheme has been evolved for the restriction of output which it is hoped will enable the collieries to keep up the price of home coal, and to make a determined attempt to recover some of the export trade on which the coal industry so largely depends.

The steel trade has also made attempts to rehabilitate itself. The help of the Safeguarding of Industries Act was sought but not obtained, and being thrown back on to its own resources, the steel makers evolved the rebate scheme,

which has been explained in previous reports. That scheme has now become part of the established routine of the steel trade and no longer arouses any comment. It is doubtful whether it has been of any real benefit to the steel makers. It has certainly not affected to any great extent the import of foreign steel, and so far the only people who have secured any tangible benefit are the consumers, who receive the rebate of 5s. or more per ton. A further step towards self-protection is the proposed scheme for control of exports of steel from this country, but as this is not yet definitely formulated it is not possible to say much about it at present.

Reorganisation of Steel Industry

The next step, and indeed the only remaining one which the steel makers themselves can take, is the drastic reorganisation of the whole industry from within. There have been numerous instances recently of this being done by individual concerns, and others are certain to follow, but these leave the main problem untouched, and it will be so until, as has before been stated, there is a weeding-out of the inefficient plants and the concentration of the industry in those which are properly equipped to meet present-day conditions. That step will have to be taken, either voluntarily or compulsorily. The only other assistance which can be given is from outside, that is, Government aid by means of protection.

So the year 1927 has closed, with its hopes and disappointments, and on the threshold of another year we are looking forward, not too hopefully, for something better than the experience of recent months. The Christmas holidays have been extended in most works, so that there will be some accumulation of orders to give a good start in the New Year, although that will not be of much use unless there is a feeling of confidence in the market, inspired by the belief that the worst has been reached and passed, and that no further downward move may be expected. If such a spirit can be infused into the market, then there will probably be a volume of buying which will give better promise for the opening year. By the middle of January, we may probably be able to see what the trend is likely to be.

The Price of Coke

The pig iron makers have obtained some relief in the prices at which forward contracts for coke have been fixed. There has been a reduction of about 2s. per ton on the last prices, and this will materially help in the cost of making the iron. It is very likely that the price of coke will tend to rise, as reports are already heard that contracts which are now being fixed are not obtaining the same reduction as those made a week or two ago. Coal prices are not so weak as they were recently, and the collieries are offering very little reduction on the prices fixed six months ago. This is the outcome of the output restriction scheme, which is now operating. At the same time, the coal owners realise that they will gain nothing by increasing the burdens of the steel makers, and there is therefore no reason to fear an advance in coal prices other than that resulting from a general improvement in trade.

There has been some wild excitement in the hematite market. A battle of prices between the East Coast and the West Coast makers has resulted in a considerable fall in the selling price, round about 4s. 6d. per ton.

In the finished trades the past month has not seen much change. Bar iron is still a very poor market, and although the price of marked bars has just been reduced 10s. per ton, there has not been any increased weight of business placed. Still another of the old iron-making firms, this time S. H. Burrows and Sons, of Sheffield, has decided that it can no longer continue to face the losses which this branch of trade is incurring, and the works are now finally closed down.

The output figures for November further reveal a falling-off in trade during the closing months of the last year. There was a decrease of seven in the number of furnaces in blast, and the output of pig iron fell from 596,300 tons in October to 575,900 tons in November. The output of steel was 698,700 tons in November, practically the same as in October, but 80,000 tons less than September.

Some Inventions of the Month

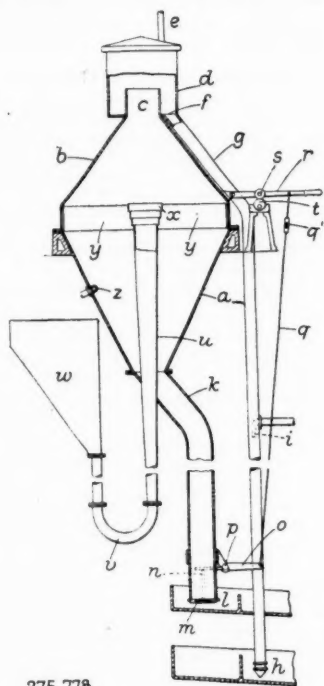
By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Flotation Processes

In a series of Patent Applications by Guggenheim Bros., New York, U.S.A., is described the use in flotation processes of organic compounds having a plurality of doubly bonded sulphur atoms, and being substantially insoluble in water. Such compounds are dioxanthogen and xanthic anhydride, instructions for making which are given. The compounds can be used in solution in oils and in the presence of a frothing agent such as pine oil. An acid or alkaline circuit may be employed. See Patent Applications 275,561-3, having the International Convention date August 3, 1926.

In the known "vacuum" process for the flotation treatment of coal and ores, the pulp is sucked into a separating chamber through a vertical or horizontal pipe. In the latter, owing to reduction of pressure and consequent liberation of dissolved gases, the volume and consequent velocity of the pulp increase progressively, and the resulting turbulence tends to detach the mineral grains from the gas bubbles; the detached grains are largely lost in the residues. The use of mechanical rakes or stirrers in the separating vessel has a similar action. These



275,778

disadvantages can be largely overcome if the pulp is sucked into the separation chamber as a substantially vertical stream at an approximately constant velocity; thus the ascending stream may have an increasing cross section. In the apparatus shown in the figure, the pulp prepared in the known manner is sucked from the hopper *w* up the pipe *u*, which increases continuously in diameter, and is fitted at the top with a series of concentric baffles *x*. A vacuum is maintained in the separating vessel *a* through the pipe *e*, and the residues are discharged through the tail pipe *h*, and the mechanically intermittently operated valve *m*; the mineral-bearing liquid or froth escapes by the opening *c* and the pipe *fg* at *h*, which is under water. To assist in the separation a jet of water may be introduced tangentially into the lower part of *a* by the nozzle *z*; radial baffles *y* prevent the rotary movement being communicated to the upper part of *b*. See Patent No. 275,778, by F. E. Elmore, Boxmoor, Herts, having the date July 16, 1926.

Protective Coatings

ARTICLES of metal or other suitable materials which are to be given a protective coating of aluminium or alloy thereof, are first given a coating of cadmium. The articles are then either treated in a bath of molten aluminium or subjected to the action of the vapour of that metal, for example, by heating them in a closed vessel with aluminium powder at 650-1,000° C. Ferrous metals in particular become deeply impregnated by this process, the cadmium being entirely displaced. The cadmium can be applied electrolytically. The process is applicable even to articles of refractory materials such as firebricks, furnace lining blocks, tiles, etc., which may be made of silicon, asbestos, or other mineral substances. See Patent No. 279,273, by W. Smith, having the date December 14, 1926.

Electrolytic Processes

A RECENT Patent Application by Siemens and Halske Akt.-Ges., Berlin, describes the production of metallic beryllium and alloys thereof by electrolysis of a molten mass containing basic beryllium fluoride or beryllium oxyfluoride together with alkaline earth metal fluorides, with or without alkali fluorides. Thus a mixture of beryllium oxyfluoride and barium fluoride may be melted in a graphite crucible (by an electric arc) and electrolysed at 1300-1350° C. using a water-cooled cathode. Volatilised salts are collected and returned to the bath. Alloys are produced by using the molten alloying metal as cathode, reference being made to alloys with copper, aluminium, magnesium, nickel, cobalt, and iron. Reference is also made to the coating of articles with beryllium by using them as cathodes in the above processes. See Patent Application 278,723, having the International Convention date October 7, 1926.

Zinc

ACCORDING to a Patent by U. C. Tainton, Kellogg, Idaho, U.S.A., the electrolysis of zinc sulphate solutions (obtained by leaching ores with sulphuric acid in the usual way) is advantageously effected when using lead anodes containing a proportion of silver with or without other elements such as tin or arsenic. The proportion of silver may be about one per cent., and for economy only the surface layers of the anodes may contain silver, the inner portions consisting of hard arsenical lead; preferably, also, two perforated anodes may be used between each pair of cathodes to secure better circulation of the electrolyte. The zinc deposits obtained on the aluminium cathodes are substantially free from lead, which, in the usual way is mechanically carried to the cathode from the anode in the form of lead peroxide. Incidentally the manganese, always present in zinc ores, is finally obtained (at the anodes) in the form of pure manganese dioxide substantially free from lead. See Patent No. 280,103, having the date April 29, 1927.

H. Wittek, of Beuthen, Upper Silesia, Germany, describes the reduction of zinc ores by means of carbides in the presence of an inert gas such as nitrogen. When sulphide ores are used, calcium or barium sulphide is obtained as a by-product and may be used for the manufacture of the corresponding carbide. See Patent Application 279,370, having the International Convention date October 23, 1926.

Finely ground zinc ores are prepared as a plastic mass, and then subjected to a kneading and thread-forming process so as to obtain particles of 2-4 mm. in diameter and 2-15 mm. length; the granules, mixed with a reducing agent also suitably graded, are charged into the usual retorts for reduction. In the case of sulphide ores the granules are subjected to a preliminary roasting process. See Patent No. 279,697, by Compagnie des Metaux Overpelt-Lommel, Belgium, having the International Convention date January 26, 1927.

Silver Alloys

SILVER alloys in which silver predominates, and which are substantially non-tarnishing, contain tin, zinc, aluminium, and gold; the tin and zinc can be replaced by cadmium; preferably the tin and zinc together are greater in quantity than the gold and aluminium, the latter metal being present in least quantity. A suitable alloy consists of 925 parts of silver, 6 parts of gold, 1 part of aluminium, 41 parts of tin and 27 parts of zinc; advantageously the alloy metals may be first fused together and then fused with the silver. See Patent No. 280,073, by R. P. Joseph, Omaha, Nebraska, U.S.A., having the date February 7, 1927.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—Copper-silicon alloys of high copper content. W. Geiss and J. A. M. van Liempt. *Z. anorg. Chem.*, Vol. 168, Part I, pp. 31-32, November 21 (in German).

ANALYSIS.—The determination of manganese in steels or alloys containing high proportions of chromium or cobalt. E. Rousseau. *Chimie et Industrie*, November, pp. 772-780 (in French).

CORROSION.—Protection against corrosion by means of metallic coatings. W. Blum. *J. Chem. Education*, December, pp. 1477-1487.

CRYSTAL STRUCTURE of Cu_3Sn and Cu_3Sb . W. M. Jones and E. J. Evans. *Philosophical Mag.*, December, pp. 1302-1311.

FLOTATION.—The present position of selective flotation. Dr. Gumbrecht. *Metall u. Erz*, December (No. 23, 1927), pp. 557-566 (in German). Objects of selective flotation; fundamentals of the process; effect of the condition and grain-size of the material; effect of oils; addition of chemicals; difference in the flotation-capacity of various minerals; separability of lead glance and zinc blende; choice of flotation medium and reagents; application of various apparatus; duration of reactions; various installations.

Advances in the flotation of oxidic ores and gangues. H. Madel. *Metall u. Erz*, December (No. 23, 1927), pp. 568-571 (in German). Application of flotation to oxidic lead and copper ores by the use of sodium sulphide; experiments on the flotation of cassiterite; behaviour of the most important gangues on flotation.

GENERAL.—Forging machines die design for deep piercing. E. R. Frost. *Trans. Amer. Soc. Steel Treating*, December, pp. 954-967. Describes the method and die design of producing upset machine-forgings having deep holes pierced through them.

Preparation of aluminium oxide for final polishing and the preservation of polished and etched surfaces. W. P. Fisher. *Trans. Amer. Soc. Steel Treating*, December, pp. 982-983.

The effect of an addition of chromium on the internal friction of reversible ferro-nickels. P. Chevenard. *Comptes Rendus*, November 21, pp. 1130-1132 (in French).

The surface ennoblement of metals by diffusion. III. The diffusion of tungsten in iron and the resistance limits of iron-tungsten alloys. G. Grube and K. Schneider. *Z. anorg. Chem.*, Vol. 168, Part I, November 21, pp. 17-30 (in German).

The theory of chromium deposition. E. A. Ollard. *Metal Ind.*, November 11, pp. 437-439 and November 18, pp. 461-464.

IRON AND STEEL.—On the constitution and properties of hardened steel. W. P. Sykes and Z. Jefferies. *Trans. Amer. Soc. Steel Treating*, December, pp. 871-904. An investigation of the changes in hardness of freshly quenched steel taking place at, above, and below room temperature. Freshly quenched high-carbon steel when maintained near 0°C . for several hours does not change in hardness. It hardens if cooled below or heated above this temperature. The maximum Rockwell "C" hardness values obtained on the carbon steels were 70.1 on a 1.23 per cent. and 70.2 on a 1.58 per cent. carbon steel.

Segregation of dissolved elements and its influence upon carbon distribution in steel. E. G. Mahin and H. J. Dillon. *Trans. Amer. Soc. Steel Treating*, December, pp. 905-920. An account of the theories advanced to explain the common coincidence of non-metallic inclusions and pro-eutectoid ferrite or cementite in annealed steel.

Relationships between Rockwell, Brinell and scleroscope numbers. R. R. Moore. *Trans. Amer. Soc. Steel Treating*, December, pp. 968-975. Gives the results of a large number of the above tests made on a number of structural alloy steels, together with tables and comparative graphs.

Notes on the spark testing of steel. G. M. Enos. *Trans. Amer. Soc. Steel Treating*, December, p. 981.

The sparks given off when ferrous materials are touched to a rapidly revolving grinding wheel are characteristic of the composition and type of the metal.

SOLDERING.—Surface tension of metals, with special reference to soldering conditions. A. W. Coffman, with S. W. Parr. *Ind. Eng. Chem.*, December 1, pp. 1308-1311. Among the conclusions it is stated that it might be possible to obtain a solder of much lower surface tension (e.g., better spreading power) than those now in use by alloying metals with widely different surface tensions and atomic volumes, e.g., thallium and bismuth or thallium and antimony.

The action of fluxes in soft soldering and a new class of fluxes for soft soldering. R. S. Dean and R. V. Wilson. It has been found that the fluxing action of the best soldering fluxes, ZnCl_2 , NH_4Cl , and SnCl_2 , depends on the evolution at soldering temperatures of HCl gas, which dry gas has been found to be an effective soldering flux. The halogens and other halogen acid gases have also been found to be effective soldering fluxes. Based on this discovery, soldering fluxes have been found among organic compounds, naphthalene tetrachloride, tetrabromide and 9:10-dichloroanthracene tetrachloride, etc., and the way opened for the development of a truly non-corrosive flux.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

CARNFORTH HEMATITE IRON CO. (1915), LTD.—Registered December 8, Trust Deed dated December 1, 1927 (supplemental to Trust Deed dated December 1, 1915), securing a conditional increase in rate of interest on £116,620 1st debentures outstanding; general charge. *£116,620 1st mortgage, £150,000 2nd debentures (collateral security), and £1,000 mortgage. April 13, 1927.

CORONIUM METAL CO., LTD. (late P. R. METALS, LTD., Reading.—Reg. October 21, mortgage collaterally securing debentures for £9,000 (part of issue of £16,000), to E. H. Craggs, Bailey's Hotel, Gloucester Road, London, consulting engineer; charged on property in Varnern Road, Reading. *£16,000 1st debentures. February 12, 1926.

EBBW VALE STEEL, IRON AND COAL CO., LTD.—Registered December 16, charge, to Barclays Bank, Ltd., securing all moneys due or to become due to the bank; charged on certain railway wagons. *£1,511,275. July 12, 1927.

KING AND CO., LTD., Hull, iron merchants.—Registered November 30, £15,000 and £15,000 mortgages, to S. Cliff, Western Flatts, Wortley; charged on 28 and 30, Jameson Street and land and premises in South Church Side, Vicar Lane, King Street, and Fish Street, Hull. *£16,750. October 20, 1927.

MONDEGO TIN DREDGING CO., LTD., London, E.C.—Registered November 29, £10,000 debentures (filed under section 93 (3) of the Companies (Consolidation) Act, 1908), present issue, £3,000; general charge. *£22,500. April 26, 1926.

MONDEGO VALLEY TIN SYNDICATE, LTD., London, E.C.—Registered November 28, £1,000 debentures, part of £10,000; general charge. *£45,000. December 2, 1926.

Satisfactions

BOLTON (THOMAS) AND SONS, LTD., Widnes, copper smelters, etc. Satisfaction registered November 14, £350,000, registered July 27, 1912.

MORTON (FRANCIS) AND CO., LTD., Garston, iron-founders. Satisfaction registered November 30, £65,000, registered July 13, 1920.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

Pyrophoric Alloys

An Account of their Production and Properties

The pyrophoric alloys (mainly derived from cerium) form a remarkably interesting group of substances. In the following article these alloys and the materials from which they are derived are discussed in detail.

THE invention of the incandescent mantle by Dr. Auer von Welsbach in 1886 at once created an enormous demand for thoria, which up to that time had been extracted almost entirely from the mineral thorite, a silicate of thorium found mainly in Scandinavia. The greatly enhanced price of this mineral which naturally followed the larger demand stimulated active research for other sources of supply. These were soon forthcoming in the shape of the heavy, golden-yellow, monazite sands occurring in various parts of the world, notably in North Carolina (United States), Brazil (on the coasts of Espirito Santo and Rio de Janeiro), and also in Nigeria, Nyassaland, Ceylon and Malaya.

An Outlet for the Ceria of Monazite Sand

Monazite sand consists mainly of the phosphates of the rare earth metals cerium, lanthanum, etc., together with about 6 per cent. of thoria. Until 1895, the deposits in the Carolinas worked by an American company supplied the world's demand for thorium. But at that time the German Thorium Syndicate began working the much more advantageously situated deposits along the shores of the southern provinces of Brazil. The German company ultimately caused the American to go out of business. Later, when, in 1911, the deposits at Travancore, India, were discovered the Auer von Welsbach company obtained complete control. The whole of the product was sent to German firms, who derived an enormous profit from the sales of small portions of sand and its products to English manufacturers. The monopoly was broken, however, by the war, which enabled the trade to enter British hands.

The incandescent mantle contains 99 per cent. of thoria and 1 per cent. of ceria, but monazite sand contains from 5 to 10 per cent. thoria and 50 to 60 per cent. of ceria and other rare earths. On this account, large quantities of rare earths minus the thoria began to accumulate at the mantle works, but Auer von Welsbach was not long in finding a use for a part at least of this, hitherto, waste product. He found that when an alloy of iron and the cerium metals was rubbed with a file numerous bright sparks were emitted. This property is very rare, and known in but few other instances in the field of non-ferrous metallurgy. It could obviously be turned to account, and was applied to the manufacture of automatic devices for lighting lamps, cigars, and so on. The alloy when "struck" ignites petrol vapour, which burns at a wick from a convenient reservoir.

These "flints," "firestones," or pyrophoric alloys are cast into thin rods, which, being very brittle, can be broken up to the requisite lengths. Welsbach discovered the pyrophoric alloys by accident, but the first one he prepared was unsatisfactory and ultimately lost its spark-emitting properties. Research soon revealed, however, that the most satisfactory mixture is one containing much cerium.

Cerium and its Properties

Cerium is the most abundantly occurring metal of the "rare earths," and in many respects resembles the alkali metals. It is steel-grey in colour, and although harder than lead, it cuts readily under the knife, presenting a brilliant metallic lustre which soon tarnishes in moist air. Even at normal temperature it decomposes water slowly and gives off hydrogen. When heated in air it burns more intensely

than magnesium. The Brinell hardness number is 28, and in this respect it falls between aluminium and antimony. No use for the pure metal has yet been found, but an alloy of it with other rare earth metals, from which thorium has been removed, is employed as a powerful reducing agent.

In the pyrophoric alloys, the rare earth elements commonly associated with cerium are lanthanum, samarium, yttrium and didymium. The base metals, such as iron, aluminium, cadmium, zinc, magnesium, manganese and cobalt, are alloyed with the cerium metals to form hard and brittle spark-emitting alloys.

Theories of the Pyrophoric Phenomenon

The explanation usually offered for the phenomenon of the sparking of pyrophoric alloys is that the minute metallic particles rubbed off by a file are sufficiently heated in the process by friction, compression, etc., to take fire when set free in the oxygen of the air. This property is not altogether unknown in certain elements. For instance, finely divided pure lead is obtained by heating lead tartrate at a low temperature in a closed glass tube. If, when formed, the cold powder be allowed to fall through the air, the oxidation of the powder proceeds so rapidly that the temperature is raised and the powder becomes red hot. Iron and nickel behave similarly in this respect.

Manufacture of "Misch Metal"

The first step in the production of pyrophoric alloys is the preparation of a mixture of rare earth metals known as "misch metal." The mixed cerium and rare earth oxides mentioned above, the waste of the mantle manufacturing plants, are first converted by a special process into the corresponding anhydrous chlorides. The chlorides, mixed with the requisite quantity of calcium chloride, are then charged into a graphite crucible and electrolysed, whereupon the mixed metals are allowed to accumulate under a covering layer of flux to prevent their oxidation. The composition of "misch metal" is about 40 to 50 per cent. cerium, 20 to 40 per cent. lanthanum, 1 per cent. of yttrium and small amounts of neodymium, samarium, gadolinium, etc.

To prepare pyrophoric alloys utilising this "misch metal," the metal of highest melting-point is charged into a crucible and melted under a layer of common salt or fluorspar, the cerium alloy being then added and mixed in. The "misch metal" alone has a tremendous affinity for oxygen, so that it has to be melted *in vacuo* when by itself. A small "flint" of spark-emitting alloy, if heated to about 400° C., suddenly becomes, of its own accord and after removal from the source of heat, red hot; it glows brightly and swells up into a large volume, cools off and leaves a deposit of oxides of the various metals which comprised it.

The Pyrophoric Alloys of Commerce

"Auermetal" is probably the best and most widely used pyrophoric alloy, and is made by alloying up to 60 per cent. of iron with "misch metal." A typical analysis is as follows: iron, 35 per cent.; cerium, 35 per cent.; lanthanum, 24 per cent.; yttrium, 3 per cent.; erbium, etc., 2 per cent.

An alloy known as "Kunheim" made by the French is a "misch metal" containing up to 2 per cent. of aluminium, 12 per cent. magnesium, and 2 per cent. of hydrogen combined as metallic hydrides. A cheaper alloy than "Auermetal"

contains 7 per cent. "misch metal," 10 per cent. antimony, 30 per cent. manganese, the rest being iron. This alloy is, however, liable to disintegrate in a damp atmosphere. A number of very uncommon alloys contain no cerium or allied elements, yet they give off sparks when struck with a file. In this case the "misch metal" is replaced by titanium. Such an alloy as this analyses: titanium, 12 per cent.; chromium, 20 per cent.; manganese, 7 per cent.; the rest being iron. This alloy is excessively hard, owing to the presence in it of titanium and chromium, both of which are very brittle. There being no cerium in the alloy, it is cheaper than those compositions already cited, but it has not been a great success, and with this exception all the pyrophoric alloys are made with "misch metal" as a base (Bertoya, *Met. Ind.*, 1918).

It will thus be seen that the manufacture of pyrophoric alloys represents an important outlet for the otherwise waste cerium and allied oxides annually accumulating in large quantities from the manufacture of thorium nitrate. About

200 tons of cerium earth are annually consumed in this industry, probably sufficient to make 3,500,000 "flints." Commercial anhydrous cerium oxide is sold at about 2s. 6d. per lb. for small quantities. Metallic cerium obtained by electrolysis of the oxide sells retail at about 5s. 6d. per ounce, this product being relatively very pure.

Other Uses for Cerium Oxide

The commercial grades of cerium oxide are really a natural mixture of the rare earths from monazite after removal of the thorium, and consist essentially of 50 per cent. cerium, 20 per cent. lanthanum, and 20 per cent. neodymium, while the balance is made up of small percentages of each of nearly all the other rare earth elements; such material sells at about 1.25 dollars (5s.) a pound. Chemically pure cerium nitrate, containing approximately 40 per cent. of cerium oxide, is sold at 4 dollars (20s.) per pound. Compounds of cerium have found application in medicine; as catalysts in the production of aniline black; and as reducing agents in photography.

The Contribution of Metallurgy to the Advance of the Motor Industry

By John A. Mathews

The Division of Industrial and Engineering Chemistry of the American Chemical Society has just held a symposium on "Chemistry's Contribution to Automotive Transportation." The paper now printed, which was read at the symposium, is of especial interest in view of the author's laudatory reference to British metallurgy.

JUST as no man liveth unto himself, so no science or branch of science can stand alone. The progress in each science makes for progress in other sciences. Metallurgy is one of the oldest of the arts and one of the newest of the sciences. In fact, the standard definition of metallurgy has not yet been changed from "the art of extracting metals from their ores and fitting them for use." The art is, at least, as old as the Christian era, but the writer distinctly recalls, during his university days in the nineties, an aversion to the study of metallurgy because it seemed to be taught as a descriptive subject dealing with facts, equipment, and processes and with little of scientific appeal. In the late nineties appeared the beginning of a particular interest in alloys, and the application of scientific methods to their study—thermal analysis, microscopy, etc.

Pioneer Work in Heat Treatment

The British Institution of Mechanical Engineers had an Alloys Research Committee with Sir William Roberts-Austen at its head, and I proceeded to his laboratory, in the Royal School of Mines, in 1900. He and his associates had just completed the thermal analysis of the iron-carbon series and Roozeboom, from Roberts-Austen's data, attempted to explain the iron-carbon diagram from the standpoint of the phase rule of Gibbs. Now it is quite likely that most automobile engineers and motor designers never heard of these men or the iron-carbon diagram and, if shown one, might inquire, what has that to do with an automobile? It is the rock on which is founded the scientific heat treatment of steel and which makes possible the quantity production and treatment of dependable parts. Its connection with production may not be so obvious, but that is because it refers to the prior heat treatment in the way of forging, annealing, or heat-treating and annealing.

While air-hardening tool steel was, so far as I am aware, the earliest commercial use of an alloy steel, yet what are ordinarily called engineering steels of the alloy types probably received their first recognition in ordnance work. It is but forty years since the first systematic study of alloy additions to iron-carbon steels was made by Hadfield in his epoch-making researches on manganese steel. A little later came nickel steels, and then a profusion of alloy steels of ternary, quaternary, and more complex types. While all these series were not systematically investigated, they have been commercially produced in limited varieties for about fifty years. Nickel steels when first produced were known as "Meteor Steels," because it had long been known that meteors are usually iron-nickel alloys with or without some cobalt. The chromium-nickel steels were used in ordnance in the latter part of the

last century, so we see that when the automotive industries began the materials for their construction were already available.

Metallurgy a Branch of Applied Chemistry

You cannot divorce cause and effect nor supply and demand, and so problems without number arose during the years of the present century and the needs of industry have been met with great success. The contribution of the ferrous metallurgist to this programme has been great. Metallurgy is a branch of applied chemistry, and, from the pure science standpoint, a backward branch. The physico-chemical studies of metallurgical processes are extremely difficult, particularly when high temperatures are involved with the usual multitude of variables, but there are a few chemists bold enough to make the attempt and the past and present workers of the Bureau of Mines research staffs have made important contributions to the subject.

Specifically, the contributions of metallurgists to automotive endeavour have been along two lines: first, the production of new alloy steels; and second, development of methods to improve the natural mechanical properties of those alloy steels by heat treatment.

New Alloy Steels

With increased demands for alloy steels, new alloys were sought and tried. In 1902, when the writer inquired for vanadium, he was quoted seventy-five dollars per pound. In a little over a year the price had dropped to forty dollars, and a few months later to twelve dollars and a half. At this price he purchased about one-half of the available supply, namely, thirty pounds, and the order was divided between two dealers, each of whom had about that amount. The first use of this vanadium was in high-speed steel in 1903, and resulted in a very great improvement and its use became general.

The introduction of high-speed steel itself, following the investigations of Taylor and White, was probably the greatest contribution of metallurgy to quantity production, not only of automotive parts, but in many lines of manufacture. The silico-manganese steels seem to have been introduced into this country [United States] by way of France, where the automotive industry developed very early. We used molybdenum in tool and air-hardening steels as early as 1896, but the development of the molybdenum engineering steels was the result of war-time activities. Few realise that with our great natural mineral resources, we are especially lacking in the special metals used in steel-making. We rely almost entirely on foreign sources for our manganese, nickel, chromium, tungsten, and vanadium.

In 1906 the first electric furnace was put into use at the Halcomb Steel Company. Several types of furnaces appeared in France, Sweden, and Italy about the beginning of this century. The introduction of electric steel in this country was of vital importance to the automotive industries. Some of the methods employed in making the first electric steel in this country, which counted for much of its success, were the use of small, tapered, big-end-up ingots, with hot tops. These had all been standard practice with us for years; in fact, they were probably first used at some of our plants. Now they have been accepted by open-hearth steel-makers to a large extent when alloy steels are to be manufactured.

It is natural to assume that the intensive work that has been done on the alloy steels and in the development of the electric furnace has not been without considerable influence in connection with the ordinary carbon-steel products as well. Great advances have been made in the manufacture of plain carbon-steels, particularly in the direction of close chemical control, even when made as the product of large-sized furnaces. These steels, as well as the alloy steels,

are sounder, cleaner, and more dependable than they were in past years before the automotive industry created a demand for superior products and the volume required made necessary the combination of quality and quantity production.

Non-Corrodible Steels

The last contribution of metallurgy to the motor industry which we will mention, is the development of non-corrosive steels. Just as the leading types of structural alloys antedated the automotive industry, so the development of non-corrosive steels was far in advance of the demand. Metallurgists responded to the need faster than buyers created a demand. Regular stainless iron and steel are of about ten years' standing, while the nickel-chrome and nickel-chrome-silicon steels have been available in the United States almost as long. Only within the past year or two have really large and important uses been made of them in chemical plant, oil refinery, and other equipment of similar nature.

In our enumeration of the contributions of chemistry, we must not forget the splendid work of those patient, conscientious men—the analytical chemists.

Developments at Hadfields

Increased Demand for High-grade Steel

It is stated by Hadfields, the famous steel manufacturers, that they are experiencing an increased demand for their higher grade steels, which they make in great variety and for which they are world famous. Their name has always been associated with steel castings and steel forgings of the highest class, and the firm was one of the first to adopt scientific methods in their endeavour to perfect the quality of their products and produce special steels to meet the arduous conditions imposed by present day engineers. Their efforts in this direction are reflected in the consistently high quality of their steels which bring them enquiries and orders from all corners of the globe.

Steels for Cars and Aeroplanes

With the advent and development of the motor car and aeroplane and a pressing need for steels possessing high tensile strength and other important mechanical properties, Hadfields' scientific knowledge and experience stood them in good stead with the result that they are in a position to supply a wide range of steels specially adapted to work of this character. To many it may not be known that their steels were used for the valves in the engine of the motor car that won the "Grand Prix" last year, and also in the engine of the British seaplane that came in first in the race for the "Schneider Trophy."

Another important line of interest to the motor trade in which they specialise is that of laminated springs for both motor cars and commercial vehicles. These springs are made of a special grade of steel known by the trade name of "Hecla S.55." A separate department, equipped with up-to-date appliances, is devoted exclusively to the construction of this class of spring.

Everybody is now familiar with the fact that Hadfields have a controlling interest in Bean Cars, Ltd., and that all the essential components of the cars and commercial vehicles made by this firm are manufactured from Hadfield Steel. It is stated that the car is giving every satisfaction and that the commercial vehicle is being sent out in thousands. The latter is a $1\frac{1}{2}$ -ton light lorry and can be supplied with bodies to suit all requirements. As evidence of its popularity, 40 have been supplied to the Post Office Mail Service in London, while the Metropolitan Police, New Scotland Yard, London, have nearly two hundred "Bean" cars and commercial vehicles, and orders are coming through from them every month. The "Bean" cars and commercial vehicles are proving very popular in Australia.

The Corrosion Problem

It is not very long ago that Sir Robert Hadfield got out some striking figures showing the enormous wastage that is continually going on, and the great economic loss to the world due to rust and corrosion of iron and steel. Whilst it is not claimed that the present state of knowledge in respect of the production of non-corrodible steels will materially reduce

these losses, great strides have been made in the last few years in the production of alloy steels of a non-corrodible character which have led to their use in industries where the problem of corrosion has been the chief factor. The Hadfield research department has made a special study, for many years, of this problem, and the firm is now in a position to supply several remarkable steels, some of which are completely resistant to a wide range of chemical agents, and others of a heat-resisting character.

"Era C.R." non-corrodible steel is being widely used with great advantage for certain classes of industrial plant in which processes using active chemical substances are carried out. Sheets as large as 20 feet in length, by 5 feet in width, and $\frac{1}{4}$ inch in thickness have been produced in this material, and his fact opens up wide possibilities in the construction of improved plant for chemical and other industrial uses. It can be rolled and forged to any shape and is admirably suitable for cold pressing and cold drawing. Hence it is becoming increasingly used for domestic utensils, motor car and ships' fittings, and for other articles where a permanently bright finish and resistance to corrosion are required. In addition to its corrosion-resisting qualities, this steel is also of particularly high tensile strength.

Another remarkable steel is "Era H.R." heat-resisting steel, which, in addition to possessing special merits as a non-corrodible steel at ordinary temperatures, maintains its high strength and does not scale or oxidise appreciably at temperatures up to 1000° C. It is therefore an excellent material for all parts, including furnace components, subjected to high temperatures and oxidising conditions, especially in the presence, as is often the case in practice, of sulphurous gases, which have proved highly destructive to many other types of material. It is being extensively used for important parts of cruisers, submarines, and aeroplanes. In the form of castings, this heat-resisting steel has been successfully applied to many purposes and in a variety of forms. Furnace racks and plates, carbonising boxes, pyrometer sheaths, recuperator tubes, muffles, and other articles too numerous to mention are being made in this material.

Manganese Steel

The preceding account describes only a few of the more recent activities of Hadfields, Ltd. As manufacturers of stone- and ore-crushing machinery they are known the wide world over, and not a little of their success in this department of industry is owing to another remarkable steel they specialise in, called "Era" manganese steel, which was invented and perfected by the chairman of the company, Sir Robert Hadfield, many years ago. Owing to the extraordinary hardness and toughness of this steel it is the supreme material for the wearing parts of crushing machines. For the same reason it is now universally used for special railway and tramway track work, certain parts of dredging machinery, and other purposes.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Institute of Metals: General Meeting

THE twentieth annual general meeting of the Institute of Metals, which will be held in London on March 7 and 8, will include several interesting functions. The new president, Dr. W. Rosenhain, F.R.S., head of the metallurgical department of the National Physical Laboratory, will be inducted into the chair by Sir John Dewrance, K.B.E., and will deliver his presidential address. Afterwards sixteen papers will be read and discussed. These include contributions from metallurgists in Germany, Japan, and the United States, as well as Great Britain. Following the papers there will be a dinner and dance at the Trocadero Restaurant, also the formal opening of the new offices and library of the institute at 36, Victoria Street, S.W.1.

The official programme of the meeting includes a notable list of new members—123 in all—which brings the membership close to the 2,000 mark. It is interesting to note what a large proportion of the new members reside abroad. An election of members is announced to take place on February 22. Particulars of membership, which now covers the period ending June 30, 1929, are obtainable from the secretary, Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, London, S.W.1.

The Metallurgy of Nickel

DURING 1927 the non-ferrous metals attracted a very fair amount of publicity, due, perhaps, in some measure to the depression which, despite the heavy production of iron and steel, prevailed in the non-ferrous group. Thus, tin had a spectacular career, although mainly from the commercial point of view. It was the centenary of the discovery of aluminium, and both the metal and its alloys came in for considerable attention, and much valuable research work was done on the aluminium-silicon group. Chromium achieved more than its usual publicity in connection with plating, and cadmium and zinc had a good scientific "Press." It was reserved for nickel, however, to have a "week" to itself, as it did in Paris, in the late autumn. The occasion was celebrated by an exhibition at the Conservatoire Nationale des Arts et des Métiers, and by the reading of numerous papers and the delivery of lectures on nickel and its alloys. The proceedings occupy the bulk of the *Revue de Métallurgie* for November and December, and the January issue also contains further reports of the papers.

"Nickel Week" Papers

THE opening address was by Dr. L. Guillet, who pointed out that the idea of holding a nickel week was not altogether novel, as an aluminium week had been held, with considerable success, some years ago. The predominance of the nickel deposits of New Caledonia has given way to that of the Canadian deposits, and the present rate of production in the French colony is little more than one-tenth of the total supply. The French company (La Société Le Nickel) partly treats the metal at its works in the island, and refines them at works in Havre. Ores from New Caledonia are also smelted by the blast-furnace company of Noumea, and refined at its works near Antwerp and in New Brunswick. The various Mond Nickel interests are, however, paramount. Dr. Guillet's address described the treatment of the ores, the reactions involved and the carbonyl process of refinement. The New Caledonia deposits differ chemically and mineralogically from those of Canada, and require quite different reduction processes. Brief reference to the Stanley electrolytic process of zinc production was made. This produces a metal which is 99.9 per cent. pure.

The Applications of Nickel

PAPERS by J. Galibourg and R. Coutal described, in greater detail, the extraction of nickel from its ores in America and in New Caledonia respectively, and the remaining papers dealt with the applications of the metal and its alloys. G. Chaudron described "Pure Nickel and its Uses," and J. Galibourg, in a second paper, dealt with "Nickel Plating."

A. Portevin read a paper on "Nickel Alloys and Corrosion"; G. Charpy dealt with "Nickel for Munitions of War"; and Dr. Guillet dealt with "Nickel in the Automobile and Aeronautical Industries." Nickel-iron alloys and castings were described by J. Galibourg, and non-ferrous nickel alloys by J. Cournot. It will be seen that the proceedings during "Nickel Week" dealt exhaustively with every phase of the subject, and the papers reported in our French contemporary constitute a very complete and up to date account of the metallurgy of nickel, its alloys, and applications. It is much to be desired that these papers might be made accessible to English readers in unabridged translations. Possibly the Bureau of Information on Nickel could assist in that good work.

Direct Reductions of Iron Ore

THERE seems to be no limit to the number of methods put forward by various inventors, for the direct production of iron from its ores. On the score of economy, the old blast-furnace method seems to be both cheap and expeditious, but, of course, the product is very far from being pure. On the other hand, "Armco" is as pure as can possibly be required, and reasonably cheap besides being plentiful, yet a Bulletin issued recently by the Bureau of Mines, Washington, listed dozens of methods for producing "spongy" iron, and the number of patents for direct processes seems to increase almost daily. One of the most recent is the Swedish Fagterskiöld process. The reduction of the ores in this process is effected by gas, and a shaft furnace is employed in the operations. In the upper zone of the furnace the ores are pre-heated by the ascending gases, which are then drawn off to a sort of producer, where they are enriched in CO by passage through "glowing carbon." After cooling, these gases are led back to the furnace and admitted to the second zone. The third zone (in the descending scale) is fed with water-gas from a separate producer, and here, it is claimed, the final reduction takes place, the reduced metal possessing the advantage of not being contaminated by carbon gases, and therefore under no compulsion to absorb carbon. In the fourth zone, the atmosphere of which is still chiefly water-gas, the resulting mass is cooled to a suitable temperature, but for what purpose is not disclosed. The process sounds complicated, and it would be interesting to have further details of the reactions involved in the different zones.

Chromium Plating

THERE is every reason to regard chromium plating as an ideal form of protective coating, once the difficulties of attaining a really perfect job have been surmounted. The metal itself is, to all intents and purposes, incorrodible; it is hard, takes a magnificent polish, and is not inartistic. In point of beauty it compares favourably with other metals, and does not assume any "bloom." Yet, for all this, chromium plating seems to halt. The chemistry, and particularly the valency of chromium are extremely complicated, and it is largely a matter of speculation as to what precisely goes on in the bath. Considering the vast amount of research work which has been done on chromium plating it is disappointing to find that its industrial applications are still so limited. Its adhesion is none too good at times, and the exact reasons for this, and for its habit of forming minute blisters—probably due to hydrogen occlusion—are still obscure. It is, however, a matter of practical certainty that chromium plating will, before long, come into its own; also that the future holds some promise that chromium plating will be applicable to the ultra-light metals and their alloys. What a truly non-corrodible and entirely trustworthy plating on magnesium would mean to the automobile and aeronautical progress of the world is impossible to describe; it can, however, be foreseen that further progress would be enormously accelerated. With chromium as a protective coating, the yet unexplored ternary and quaternary alloys of aluminium, magnesium, and beryllium may well have some marvels in store for the engineer of the future.

Silver Alloys

W. GUERTLER has investigated the tarnish and corrosion resistance of a wide range of silver alloys. Hitherto the alloys chiefly studied have been those of silver and copper, which possess many disadvantages. 5 to 6 per cent. of copper suffices to give rise to a net-work of copper crystals throughout the mass, and with such an alloy contact with acid comestibles results in a deposit of verdegriis. The saturation point of silver with the metals with which it is most frequently alloyed is as follows:—

Metals.	Temp. ° C.	% in the cold
Manganese.....	—	9/20
Zinc.....	710	23/20.4
Cadmium.....	724	38/32
Tin.....	724	13.3/11
Antimony.....	560	15/10
Aluminium.....	777	6/5.5
Magnesium.....	492	31/28(?)

The mechanical properties of most of the binary alloys have, within these limits, been studied. With ammonium sulphide a black deposit of silver sulphide was obtained with silver-chromium and silver-nickel alloys; probably the percentage of the two latter metals was insufficient to prevent corrosion. In the case of the cadmium alloys a yellow colouration occurred. A diagram showing the corrosive effects of citric acid, acetic acid, and other organic acids was plotted. The diagram affords useful indications as to the behaviour of the silver alloys with food acids.

Apprentices in Non-Ferrous Metal Industry

THE third of a series of reports incorporating the results of an inquiry made by the Ministry of Labour in 1925 and 1926 into apprenticeship and training for the skilled occupations, has just been published (H.M. Stationery Office. Pp. 110. 3s. 6d.). In the section on the manufacture of copper, brass, zinc, tin, lead, aluminium, etc., it is indicated that there is no apprenticeship except among maintenance workers. The total number of male workpeople employed in Great Britain and Northern Ireland is about 40,000, of whom about 18 per cent. are under 21 years of age. The majority enter at the age of 16 or 18 years. They are employed upon unskilled and semi-skilled work as shop boys, carriers of samples, etc. They are not taught a trade under any definite system of training, but acquire experience while working in association with older men. In the manufacture of copper and nickel, attendance at evening schools is definitely encouraged.

Apprentices in Metallurgical Chemistry

RETURNS were received from 91 firms employing a total of about 18,492 workers—that is, 46 per cent. of the industry. Only 14 of these firms employed apprentices or learners. The total number of apprentices and learners employed was only 98, including 9 chemists' apprentices and 89 apprentices and learners on maintenance work. Chemists' apprentices or learners are employed by some firms; the usual ages of commencement are 14, 15 or 16 years, and the period may be five or seven years. Wages are usually on a scale from 10s. per week in the first year to about 32s. per week at the age of 20 years. One firm making a return employs learners in the metallurgical laboratory for 10 years from the age of 14 years, the salary being from £40 by annual increments of £15 to £175 per annum. In another firm boys of 16 years start at 20s. per week, rising to £4 per week at 25 years; they are, however, only trained for routine analyses and do not usually become fully qualified chemists. The apprentices and learners are expected to supplement the practical work in the laboratory by regular attendance at technical classes in metallurgical chemistry.

Metallurgical Training at Birmingham

AT a social function held in the metallurgical department of the University of Birmingham on Tuesday, January 24, an opportunity was afforded of noting the progress that is being made in metallurgical science. Professor D. Hanson, the head of the department, stated that the principal function of the University was to train men for the metal industries both at

home and abroad. The changes in metallurgical science during the past two decades had been very considerable, and had necessitated an alteration in the nature of the education of metallurgists. Formerly a metallurgist was a sort of chemist. Metallurgists were finding posts not only in metallurgical works, but in a wide variety of engineering works, such as those concerned with automobile, locomotive, shipbuilding and general engineering. At the present time the prospects for men entering upon courses of instruction in metallurgy were most promising since the number of posts available exceeded the supply of men. In the past, practical courses in metallurgy in universities had been largely chemical in character, and the need was now felt for the development of new courses, particularly those dealing with the operations of the casting and heat treatment of metals.

The metallurgical department of the University has recently installed a considerable amount of new plant, with which it is hoped to work out courses of training which will enable the students to deal with larger quantities of metal and to study the operation of melting, working, and subsequent treatment on a sufficiently large scale to make them acquainted with the difficulties likely to be met with in industrial practice.

Cast Iron Research Bulletin

THE January issue of the *Bulletin* of the British Cast Iron Research Association (No. 19) contains, among other things, Bureau Reports Nos. 37 and 38. The former, by Dr. A. B. Everest, deals with "The Influence of Nickel and Chromium on Cast Iron," and is intended to bring up to date the former bulletin on the same subject (No. 16, April, 1927). Bureau Report No. 38 is concerned with "The Wear of Cast Iron," separate headings in it being automobile pistons and cylinders; brake blocks; locomotive valve rings; and work hardening. Research reports Nos. 36, 40, 43, 44, 45, and 46 have been issued. They deal respectively with "The Effect of Carbon on Whiteheart Malleable Cast Iron (British Hematite Base)" (E. R. Taylor); "The Effect of Carbon on the Mechanical Properties of Whiteheart Malleable Cast Iron (Hematite and Swedish Bases)" (E. R. Taylor); "The Effect of Different Rates of Solidification on Structure and Mechanical Properties of Whiteheart Malleable Cast Iron" (J. E. Fletcher) and "The Mechanical Properties of Chill *versus* Sand Cast Whiteheart Malleable Cast Iron" (E. R. Taylor); "The Magnetic and Electrical Properties of Cast Iron" (J. H. Partridge); "The Graphitisation, Carbonisation, and Oxidation of Iron and Iron Alloys" (M. L. Becker); and "The Influence of Aluminium on Cast Iron" (A. B. Everest).

Sierra Leone Platinum

THE announcement by the Colonial Office of the discovery of platinum in Sierra Leone (see THE MONTHLY METALLURGICAL SECTION for January 7, p. 5) has created a good deal of speculation as to the ultimate commercial effect of the new source of supply. With such scanty information available as to the nature of the new deposits, official and expert opinion is naturally reserved. It is agreed, however, that the discovery is highly encouraging. The fact that in the course of less than two years' work Major N. R. Junner, the director of the survey responsible, has made two important finds—first of hematite, then of platinum—is regarded as a splendid vindication of the success of the policy of geological surveys for the whole of the Empire.

Russia, which before the war supplied 90 per cent. of the world's platinum, is largely responsible for the scarcity and the price of the mineral to-day. According to the estimates of the Mineral Resources Department of the Imperial Institute, her output in 1926 was some 60,000 ounces. Compared with her 1913 record of 157,000 ounces crude (representing 83 per cent. of platinum), that figure is very small, though it tells of a rapidly recovering rate of production.

The chemical, electrical, dental, and jewellery industries remain the largest users of platinum to-day. For many of its original uses no satisfactory substitutes have yet been found, and industry will await details of the capacity of Sierra Leone with unabated interest. No news is yet available concerning the development of the Sierra Leone deposits. Rumours are in circulation in London, however, to the effect that a firm engaged in platinum production in South Africa is considering the matter.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

WE have now passed through the first month of the New Year, and there may be some little satisfaction in the knowledge that conditions in the iron and steel trade are no worse than they were at the close of last year. Many of the trade reports would seem to indicate that there is a slight improvement, that the depression which characterised the latter part of 1927 is about to lift, and that the steel works will enjoy a greater measure of prosperity during the present year. One would like to believe that that is a correct statement of the position. Certainly the experience of the trade in the month of January does not give any real justification for such a belief. The only improvement is in the optimistic outlook of those who would try to persuade themselves that the industry is at last on the road to recovery from the depression which has weighed it down so long.

Such a belief is welcome even though there may be no substantial basis for it. It may have been encouraged by the fact that in the early part of the year there are always contracts to be renewed, particularly those for the railway companies, which are one of the mainstays of the iron and steel trade. But these are only renewal orders; they do not represent that increase in trade which is so urgently required, and which is a vital necessity to the well-being of the industry. The works must have, of course, a continuation of the regular business which keeps them going at all, but what is wanted is the extra trade which will make up the difference between partial and full time operation, which will enable all the works to run their plant to such an extent that it will be possible to bring production costs into economic accord with selling prices. That is what we must have before we can truthfully talk about an improvement in trade; and there has been nothing in the actual trade conditions of January to warrant the suggestion that such an improvement is in sight.

Buyers Waiting

To be quite candid, the amount of business which has passed has not been up to expectations, and there has been no buying of any magnitude, apart from the renewal of contracts to which we have just referred. Buyers still prefer to wait before committing themselves too far ahead, as they are not yet satisfied that the lowest level of prices has been reached. They know that they cannot go wrong if they continue to buy cautiously, covering immediate requirements only, and so leaving themselves free to take quick advantage of any further fall that may be announced. They know as well as the steel makers do that present prices are altogether unremunerative for the makers, but they are not concerned with other people's troubles, and so long as they can strengthen their own position they are quite ready to do so irrespective of the difficulties of the steel makers.

In this they are encouraged by the action of some of the makers. In some cases works representatives have advised buyers to defer making forward contracts in view of the possibility of a further fall in steel prices, and although there is no reason or excuse for such advice apart from the desire to gain orders over the heads of other works who do not resort to this form of advertising, it has its influence on the consumers, and it confirms them in their policy of buying from hand to mouth.

The Birmingham Quarterly Meeting

This attitude on the part of consumers was clearly revealed at the recent quarterly meeting at Birmingham. The meeting was rather disappointing. It did not reveal that strength in the market which had been expected and which the various trade reports had led one to expect. On the contrary, buyers were very reluctant to place orders and made no secret of their intention to wait until lower prices were available. It is true that the association prices for steel remain unchanged, and that is a tribute to the strength of the associations, as there is not the least doubt that if there were no control there would be an immediate fall in prices, due to the scramble there would be to secure the greatest share of the tonnage available. Consumers are perfectly well aware of this, and

they are secure in their knowledge that while such conditions continue there is no likelihood of an advance in prices. They therefore wait for what they consider to be an inevitable reduction.

Outside the controlled materials, prices continue to droop. Boiler plates, which have been very helpful to the steel makers in equalising the losses on other products, are again being subjected to very fierce competition, and some of the prices now quoted reveal the lengths to which the works are forced to go in their desire to get orders. Such competition is not only unnecessary, it is directly harmful. Quotations are being made by one or two works which surprise even the buyers, and these quotations are merely throwing money away. A recent contract for boiler plates was placed with a maker who quoted a price more than 20s. per ton below any other maker. He would have secured the contract had he quoted 15s. or 20s. per ton more. The result is that he loses so much per ton, and that particular market is spoiled for all the makers. That is not an isolated case; it is happening frequently with all other products which are similarly capable of carrying a price which will yield a fair profit to the maker. It is one step further in the process of elimination by which the weakest firms will ultimately have to close down.

Small steel bars are also being sold at extremely low prices. Here again the need for orders is so great that price becomes a secondary consideration, and the consumer can almost dictate his own terms.

Pig Iron

Pig iron is experiencing the same conditions as steel. Business is very restricted and in some cases prices have been shaded a little. This weakness has only served to confirm the buyers in their waiting policy, and contracts are not being placed as might be expected in view of the expiry of last year's contracts. Generally speaking, the pig iron makers are averse to making any further reductions in price, preferring rather to refuse orders. The hematite market weakened still further owing to the competition between the East and West Coast brands, but it is safe to say that prices have now touched bottom and the next movement will be upwards.

There is no improvement in the price for semi-finished steel; orders for billets are still subject to very severe competition, varying according to the locality in which the steel is used. Continental prices have shown a tendency to advance, particularly the German prices, no doubt owing to the expected increase in cost which will follow the new regulations as to working hours. With regard to finished steel, all the works still complain of the shortage of specifications, particularly for plates. The orders, however, are not forthcoming. There may be a slight improvement during the next week or so, as the railway contracts have just been settled, and the various stores departments will now be in a position to send out orders for their requirements, which have been held up pending the settlement of the contracts.

High 1927 Steel Output

Some degree of surprise was manifested when the published returns showed that the total output of steel for the year 1927 was about 9,100,000 tons. This is the largest output since 1918, and is only half a million tons lower than the record in 1917. It is true that the exceptional activity of the first quarter of the year, as a consequence of the termination of the coal strike, was largely responsible for this large total, but the second half of the year was one of general slackness and comparative depression. Even a nearly record output is altogether insufficient to bring prosperity to the steel trade. We cannot expect to increase that output, or easily to maintain it, unless something unusual occurs to develop the trade; and where that is to come from one is at a loss to say.

The December output figures show a further decline, for which the Christmas holidays accounted to some extent. There were six blast furnaces less in operation at the end of the month, and the production of pig iron amounted to 559,100 tons, compared with 575,900 tons in November. The production of steel was 604,900 tons, compared with 698,700 tons in November.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Iron

In Specification 278,167 is described the reduction of iron ores by means of reducing gases prepared from pulverulent fuel and oxygen or air enriched in oxygen. In a Patent of Addition thereto the method is extended to the use of reducing gases similarly prepared from gases or vapours containing hydrocarbons, for example, natural gas, coke oven gas, and gases from cracking processes; the hydrocarbons are converted principally into carbon monoxide and hydrogen. An example is given according to which the reducing gas (prepared from natural gas and air containing 45 per cent. of oxygen) contains 50.1 per cent. hydrogen, 22.5 per cent. carbon monoxide, 3.1 per cent. carbon dioxide, 1.4 per cent. methane, 4.1 per cent. water, and 18.8 per cent. nitrogen. See Patent No. 280,976, by J. Y. Johnson, London (from I.G. Farbenindustrie Akt.-Ges., Germany), having the date June 19, 1926.

Cast irons suitable for chill castings or having wear-resisting properties are described in Patent Applications by the International Nickel Co., New York, U.S.A. They contain 2-4 per cent. of carbon, small amounts of silicon and manganese, 1-12 per cent. of nickel and up to 4 per cent. of chromium; the nickel content generally exceeds the chromium content. See Patent Applications 279,414 and 279,415, having the International Convention date October 21, 1926.

Heat Treatment of Ores

WHEN sintering or roasting ores in the Dwight-Lloyd furnace a single air-blast is generally used to supply the combustion air and for the subsequent cooling of the charge, although separate air supply has been proposed for the sintering or roasting zone. According to a patent by A. L. Mond, London, from the Metallbank and Metallurgische Gesellschaft, Frankfurt-on-Main, Germany, the air blast is much

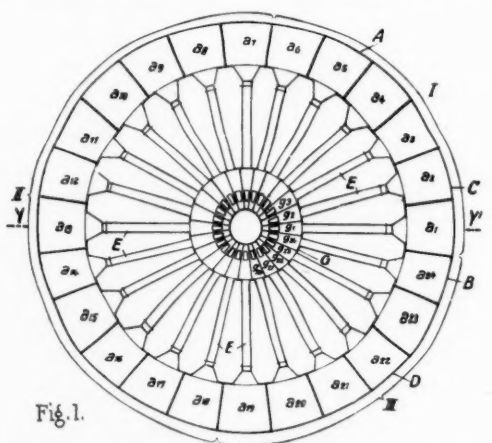
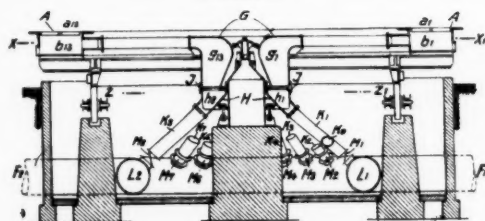


Fig. 1.



279,693

Fig. 2.

further sub-divided so as to permit more accurate control of the combustion and cooling. In the circular Dwight-Lloyd furnace shown in the figures (Fig. 1 being a horizontal section along the line X—X¹ of Fig. 2 and Fig. 2 a vertical section along the line Y—Y¹ of Fig. 1), the rotatable annular

grate *A* is divided into a number of sections a_1 — a_{24} and is provided with air chambers *b*, and pipes *E* opening into a conjointly rotating chamber *G* divided into compartments *g* corresponding with the number of grate segments *a*; a stationary chamber *H* beneath *G* is divided into compartments h_1 , h_2 , etc., which are grouped into two suction zones; the first zone comprises a sufficient number of the compartments *h* (and their connecting pipes *K* and regulating devices *M*) to ensure that each grate segment moving through the zone coincides with a suction compartment *h* and is supplied with a regulated amount of air; in the second zone there is a smaller number of suction zones so that one compartment draws air through several grate segments. The two zones are allotted fans which remove air, etc. through the pipes *F*₁ and *F*₂ respectively. The grate segments are charged at *B*, the charges ignited at *C*, and discharged at *D*; the first zone lies within the area *I*, the second zone within the area *II*, and the suctionless zone within the area *III*. See Patent No. 279,693, having the date February 28, 1927.

Alloys

THE British Thomson Houston Co., London, describe iron alloys suitable for electric resistances. They contain 2-6 per cent. of aluminium, 10-15 per cent. of chromium, and up to 0.1 per cent. of carbon. The iron and chromium are melted and run on to the aluminium protected by a flux such as cryolite. See Patent Application 280,537, having the International Convention date November 9, 1926.

The I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Maine, Germany, vary the processes of their prior Specifications No. 182,948 and No. 210,287 for purifying magnesium and magnesium alloys by causing them to contain up to 0.1 per cent. of manganese. See Patent Application 280,530, having the International Convention date November 13, 1926.

According to a Patent by H. Wade, London, from the International Nickel Co., New Jersey, U.S.A., corrosion-resistant cast iron containing 5-35 per cent. of nickel is characterised by containing 2-15 per cent. of chromium, the nickel being present in greater proportion than the chromium; the proportion of carbon usually found in cast iron is also present, and other metals may be present. The castings obtainable are stated to be as resistant to 5 per cent. sulphuric acid as are lead, bronze, or "Monel" metal; the resistance to an aerated sodium chloride solution is also much greater. The examples of alloys given contain 15-30 per cent. of nickel and 3-5 per cent. of chromium. See Patent No. 281,051, having the date October 4, 1926.

Coating with Zinc or Tin

IRON articles to be coated with tin or zinc, are prepared by cleaning with acid and dipping into a molten bath of fluorine compounds with zinc chloride or with zinc ammonium chloride; they are then entered into the tin or zinc bath, the latter preferably containing aluminium, which reduces any zinc oxide present. Conveniently, in the case of zinc coatings, a layer of molten zinc floats on exit side of a molten lead bath, while the molten fluoride-containing bath floats on the inlet side; the articles to be coated are introduced through the fluoride bath, through the lead bath and out through the zinc layer. The cleaning bath may contain 0.5-6 per cent. of potassium fluoride, 10-20 per cent. of ammonium chloride, and 74-89.5 per cent. of zinc chloride. It is not necessary to dry the articles after the acid bath treatment and prior to entering them into the salt bath. See Patent No. 281,357, by T. Liban, Cracow, Poland, having the date July 20, 1926.

Platinum

ACCORDING to a Patent by J. W. Mellor, Stoke-on-Trent, platinum is extracted from its ores by treating the finely sub-divided material with molten lead or other molten metal which dissolves platinum. The same lead is used to extract successive quantities of ore until it is sufficiently rich in platinum to pay for its treatment, for instance, by cupellation. Preferably the ore dust is blown through the molten lead by a current of gas such as producer gas which will not oxidise lead; the gangue and dross are removed from the surface by blowing or skimming. An addition to the lead of a little alkali or alkaline earth metal, say 0.1 per cent., renders it more active. See Patent No. 282,543, having the date November 18, 1926.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—Chemical affinity in metallic alloys, especially solid solutions: A study in compressibility. R. F. Mehl and B. J. Mair. *J. Amer. Chem. Soc.*, January, pp. 55-73.

Internal pressures in metallic solid solutions. R. F. Mehl. *J. Amer. Chem. Soc.*, January, pp. 73-81.

ANALYSIS.—Determination of manganese in steel by the Procter-Smith reaction in presence of phosphoric acid. B. C. Mukerjee. *Analyst*, December, pp. 689-692.

The determination of manganese in steels or alloys in the presence of large quantities of chromium or cobalt. *Die Metallbörse*, January 11, pp. 62-63; January 18, pp. 118-119 (in German).

CHROMIUM PLATING.—The Bosse process of chromium plating. W. Pfanhäuser. *Metal Industry* (New York), January, pp. 28-29.

Anodes for chromium plating. O. P. Watts. *Brass World*, December, 1927, pp. 405-407. After trying out various materials in a chromic acid plating bath lead anodes were found most serviceable for long-continued operation.

CORROSION.—Tin plate and the electrochemical series. E. F. Kohman and N. H. Sanborn. *Ind. Eng. Chem.*, January 1, pp. 76-79. Experiments have been made to determine the mechanism of the corrosion of tin and iron, both when and when not in contact, in fruits. In a number of fruits tin is anodic to iron. The data indicate that this is rather general in canned fruits. Many of the facts which did not conform to the older idea that tin is cathodic to iron are readily explained in accordance with these new findings.

CORROSION-RESISTANT MATERIALS.—Corrosion-resistant steels. L. Persoz. *Revue Chim. Industrielle*, December, 1927, pp. 397-400 (in French).

GENERAL.—The production of magnesium amalgam by an electrochemical method and its decomposition in air. N. W. Kondyrew. *Berichte Deutsche Chem. Gesell.*, January 11, pp. 208-212 (in German). The amalgam is produced by electrolysis of magnesium methyl bromide, using a magnesium anode and a mercury cathode.

HEAT TREATING, ETC.—Furnace development in heat treating and forging. W. M. Hepburn. *Trans. Amer. Soc. Steel Treating*, January, pp. 126-141.

IRON AND STEEL.—On a new method of quenching steels in a high temperature bath. K. Honda and K. Tamaru. *Trans. Amer. Soc. Steel Treating*, January, pp. 95-104, 125. Gives a method of quenching steels in hot media so that a troostitic or sorbitic structure is obtained immediately, without tempering. By the use of a hot quenching medium there is also little chance of the formation of quenching cracks. The structure of a steel quenched in a bath at 930° F. (500° C.) is sorbitic. The mechanical properties are not inferior to those of a steel quenched in water and then tempered.

The economic value of nickel and chromium in grey iron castings. D. M. Houston. *Trans. Amer. Soc. Steel Treating*, January, pp. 105-125.

MACHINING.—Machinability of metals. O. W. Boston. *Trans. Amer. Soc. Steel Treating*, January, pp. 49-94.

MECHANICAL PROPERTIES.—On the process of the failure of metals under tensile stress. K. Yuasa. *Proc. Imperial Acad. Japan*, November, pp. 603-606 (in English).

SINGLE METALS.—Nickel. The position of the metallurgy of nickel. L. Guillet. The metallurgy of nickel in Canada and the United States. J. Galibourg. Nickel in New Caledonia. R. Contal. Pure nickel and its application. G. Chaudron. Nickel plating. J. Galibourg. *Revue Metallurgie*, November, pp. 621-626, 627-645, 646-653, 654-659, 660-670 (in French). Papers read during the "Nickel Week" held in Paris last October.

The velocity of solution of zinc in a stream of sulphuric acid. M. Straumanis. *Z. physikalische Chem.*, Vol. 120, Parts 5-6, pp. 370-388 (in German). A new method for the determination of the velocities of solution of metals in streaming acids is described.

The electrochemistry of beryllium. S. Bodfors. *Z. physikalische Chem.*, Vol. 130, pp. 82-89 (in German).

The electrolytic production of magnesium from fluoride melts containing magnesium. G. Grube. *Z. Elektrochem.*, November, pp. 481-487 (in German).

The application of cadmium in metallurgy. *Die Metallbörse*, December 17, 1927, pp. 2806-2807; January 7, p. 35 (in German).

WELDING.—How to weld Monel metal. *Oxy-Acetylene Tips* (published by the Linde Air Products Co., New York), December, pp. 86-88.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

ALUMINIUM CORPORATION, LTD., London, S.W.—Registered January 12, £16,500 C debentures, part of £500,000; general charge. *£1,247,522. August 12, 1926.

ARISTON GOLD MINES, LTD., London, E.C.—Registered January 12, assignment of mortgage for £20,000, to bank; charged on unpaid instalments on share capital.

GROVESEND STEEL AND TINPLATE CO., LTD., Gorseinon.—Registered January 9, substituted security (supplemental to Trust Deed dated January 3, 1924, securing £600,000 debenture stock and premium of 3 per cent.); charged on hereditaments at Llansamlet. *£909,500. August 17, 1927.

MONDEGO TIN DREDGING CO., LTD., London, E.C.—Registered December 29, £1,000 debentures, part of £10,000; general charge. *£22,500. April 26, 1926.

PICKLES (RUPERT H.), LTD., Mytholmroyd, ironfounders.—Registered January 2, debenture, to bank, charged on Empress Foundry, Mytholmroyd; also general charge.

Satisfactions

GENERAL IRONFOUNDRY CO., LTD., London, E.C.—Satisfaction registered January 14, £700, part of amount registered October 26, 1923.

KERMODE'S, LTD., Liverpool, ironfounders.—Satisfaction registered January 11, £1,000, part of amount registered April 4, 1912.

London Gazette, &c.

Companies Winding Up Voluntarily

SOUTH AMERICAN COPPER SYNDICATE, LTD. By special resolution, December 19, confirmed January 6. E. R. D. James, F.C.I.S., 2, Broad Street Place, London, appointed as liquidator.

SPENCE METAL REFINING CO., LTD.—F. C. T. Lane, Chartered Accountant, 2, Norfolk Street, Strand, London, W.C.2., appointed as liquidator, December 21.

Big Steel Pipe Order

THE Derwent Valley Water Board has awarded to the South Durham Steel and Iron Company, Ltd., West Hartlepool, through their pipe selling agents, Cochrane and Co., Ltd., Middlesbrough, a contract for the supply of over 7,000 tons of 47 in. diameter mild steel pipes. These pipes, which will be of material of entirely British manufacture, will be made at the new steel pipe works of the South Durham Steel and Iron Company, Ltd., Stockton-on-Tees. The outstanding feature of the contract is that the pipes will be protected against the ravages of corrosion by means of a bituminous lining applied centrifugally under the Talbot patent lining processes. These patent processes are now being largely utilised by waterworks engineers in Great Britain and the United States for the protection of their steel and cast-iron mains.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

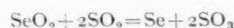
The Extraction and Uses of Selenium

By G. Malcolm Dyson, Ph.D., A.I.C.

Selenium is coming into increasing use in a number of directions and there is therefore much of interest in the following article, in which Dr. Dyson deals with the extraction and uses of the element in his customary attractive style.

SELENIUM is one of the few elements that have crept almost unobserved from the state of a mere scientific curiosity to that of a necessary and important industrial chemical. Thus whilst in 1908 the production of selenium was insignificant, the U.S.A. production in 1920 was 92,141 lb., valued at \$175,508. Since that time, the American production has fallen slightly, partly owing to the fact that German production has increased of recent years, and partly owing to the fact that the years 1919 and 1920 were marked by over-production. In 1922 there were three companies in the U.S.A. producing

sulphuric acid plant. Reduction of the selenium oxide takes place thus:



and in the comparative stillness of the lead chambers the finely divided selenium which is produced in this way is deposited and forms a red sludge at the bottom of the chambers. This sludge, which is periodically removed from the chambers, washed with water, and dried, is the raw material from which the selenium of commerce is prepared.

Crude Selenium

The earliest method of preparation to be used on anything like a large scale was the burning of the lead chamber sludge with the formation of selenium dioxide, which may be readily condensed in the form of white crystals. The selenium dioxide was then dissolved in water, and the selenium precipitated by the passage of sulphur dioxide through the aqueous solution of selenious acid. The retort shown in Fig. 2 gives a general idea of the apparatus used in this process. A group of such retorts is connected to a single large sublimation chamber. As may be seen from the diagram, the retort

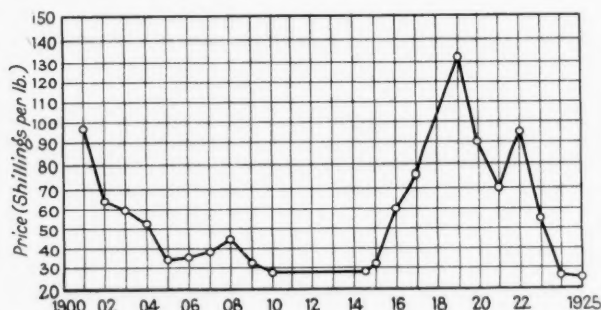


FIG. 1. FLUCTUATIONS IN THE PRICE OF PURE SELENIUM.

selenium, but in 1923 the two firms which remained producers accounted for 64,000 lb. of selenium, valued at \$134,400. The growing use of selenium is reflected in the market price, which has dropped to about 25s. per lb. for the pure fused variety. This figure is, as may be seen from the above graph, slightly less than the pre-war level. It must, however, be borne in mind that these prices are for the pure redistilled substance and not for the commercial powdered variety.

Selenium does not occur very abundantly in nature, although it is fairly widely distributed. It occurs native, being associated with the sulphur deposits in the volcanic districts of the Lipari Islands, Kilauea and Japan. It imparts to the sulphur a peculiar reddish tint which is very easily recognised. A few rare minerals are derived from the metallic selenides, notably crookesite, $(\text{Cu-Tl-Ag})_2\text{Se}$; onofrite, $\text{HgSe} \cdot 4\text{HgS}$; clausenthalite, PbSe ; lehrbachite, $\text{Pb} \cdot \text{HgSe}_2$; and eucairite, Cu-AgSe . It is not, however, from minerals of this nature that the selenium of commerce is prepared, but from the very small traces of selenium which are contained in the various forms of pyrites, especially those from which copper is smelted. The Scandinavian pyrites are particularly noted for the presence of selenium, as are also those from the various mines in the Harz district, especially from the celebrated Mansfeld mine, where the selenium has been extracted commercially for many years. Selenium is not, of course, the prime subject of the metallurgical operations, but is recovered together with nickel and molybdenum from the smelting operations which have as their main object the extraction of copper together with the manufacture of sulphuric acid from the sulphur dioxide produced in the burning of the pyrites.

As the pyrites is burnt the selenium becomes oxidised to selenium dioxide, which escapes with sulphur dioxide into the

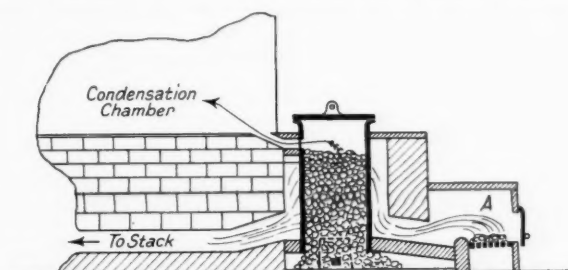


FIG. 2. FURNACE FOR THE PRODUCTION OF SELENIOS ANHYDRIDE.

is cylindrical, about 18 in. high by 8 in. in diameter, and is heated from the fire placed before it at A. The hot gases circulate round the retort and finally escape by a flue at the rear end of the plant. The upper part of the retort is closed by a lid, and has a flue leading into a large brickwork condensing chamber, which is, of course, also connected with a flue. The charge for the retort is prepared by stirring coke broken and sifted to $\frac{3}{4}$ in. pieces with the washed sludge from the lead chambers. This impregnated coke is dried out at a gentle heat and packed into the retort fairly loosely, so that air, which has access to the bottom of the retort, may circulate freely through the lumps.

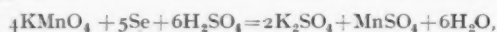
At the Mansfeld refinery, a form of pumice stone is used to replace the coke. The firing of the furnace requires considerable care; as the retort becomes heated, the selenium burns, and heating must be so regulated that the selenium keeps well alight, but does not burn so rapidly that partial distillation of unburnt selenium into the receiver takes place. After several charges, the condensing chamber is opened and ventilated, and the greyish white crystals of SeO_2 are dug out. It may be neutralised and converted into sodium selenite as described later, or it may be dissolved in water,

and the selenium precipitated by a current of sulphur dioxide. Much selenium is wasted in this process, since a considerable amount remains unburnt in the residue from the retort, whilst part of the oxide remains uncondensed. In this way about 30 per cent. of the selenium remains unaccounted for.

Some idea of the concentration effected in the various steps of this extraction may be obtained from the following figures. The raw pyrites contain about 0.005 per cent. of selenium, about 95 per cent. of which passes into the lead chamber sludge, so that upwards of 20,000 tons of pyrites must be worked before one ton of selenium has been collected in the sludge. The sludge contains about 6-7 per cent. of selenium, so that the one ton of selenium requires the handling of about 15 tons of sludge. It will be readily seen that the loss of 30 per cent. of the selenium in this process of extraction renders it commercially impracticable, in spite of the fact that no material costs have to be added to the cost of production by this method. A further disadvantage lies in the fact that selenium prepared from the selenium dioxide obtained in this way invariably contains about 0.5 per cent. of lead, by reason of which it is quite unfitted for the construction of photo-sensitive electrical apparatus, its sensitivity being destroyed by the presence of this impurity. For these reasons, other methods have been devised for the extraction of the element.

Wet Methods of Extraction

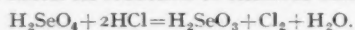
The wet method for the extraction of selenium from chamber sludge may be divided into three groups, involving (a) permanganate, (b) chlorate, and (c) sulphur trioxide, all of which act as oxidising agents. In the permanganate process the sludge is treated in sulphuric acid solution with potassium permanganate, which oxidises the selenium to selenious acid, thus:—



while the lead is converted to lead sulphate, which is virtually insoluble in the diluted reaction liquid. The process is conducted as follows. Sludge containing the selenium values (100 parts) is gently triturated with a little water in a large earthenware digester until the lumps have been smoothed out, when half its weight of sulphuric acid (62 per cent. H_2SO_4) is added, and the whole stirred, whilst potassium permanganate is added in small instalments, not exceeding 100 gm. The rapid addition of large quantities of permanganate may be attended by serious explosions, due to the formation of permanganic anhydride.

The actual amount of permanganate to be used may be calculated from the equation above, and from an assay of the crude values, but in practice this is not necessary, since the end of the oxidation is shown by the grey-white colour of the suspended matter (selenium, which gives it its original red colour, having been removed), and by the Bordeaux Red colour of the liquor. At the end of the oxidation, hydrochloric acid (3 parts) is added, followed in ten minutes by water (200 parts) warmed to 70° C. A little bisulphite is sometimes necessary to remove any permanganate that remains in solution. The whole is then allowed to cool and the precipitate to settle. It is of the utmost importance that the liquor should be crystal clear before syphoning off, since any suspension of calcium sulphate will ultimately be found mixed with the selenium, and exercises a very marked deleterious effect on the yield of pure selenium.

The clear liquor is treated with sulphur dioxide by blowing the gas from the pyrites burners through it for about four hours, this not only serving to reduce the selenious acid to selenium, but also warming the liquid to 50-60° C., thus helping to coagulate the particles of precipitated selenium, which are allowed to settle before filtration, washing, and drying. Practically all of the selenium goes into solution during the oxidation process, but only 80-85 per cent. is reprecipitated by sulphur dioxide, the remaining 15-20 per cent. remaining in solution as selenic acid, which is not reduced by the reagents used. The selenium may be extracted from the liquor by concentration and boiling with hydrochloric acid, which effects its reduction to selenious acid:—



In practice it is concentrated, allowed to stand, and separated from the potassium sulphate which crystallises out; and after boiling with hydrochloric acid, returned to the extraction cycle. In certain refineries, the mixture of selenic acid and

hydrochloric acid is used to dissolve the gold and platinum from electrolytic copper refining sludges. The sludge which separates from the oxidation process contains about 77 per cent. of lead sulphate, together with 15 per cent. of calcium sulphate, and is smelted for lead. It is this lead which goes a considerable way to reducing the cost of the production of selenium by this process.

The Chlorate Method

Where potassium or sodium chlorate is used as the oxidising agent almost the same technique is employed, save that the acid used is slightly more dilute, to avoid the risk of explosion, whilst in addition the chlorate is added more slowly. The whole of the reaction mixture is heated to about 70° C. in order to make the selenium dissolve more rapidly, and the end of the reaction can be judged by the colour of the solution after a test sample has been boiled. If the solution is colourless or pale green, the iron present is still in the ferrous state and further oxidation is necessary; when all the selenium has been oxidised the suspended matter appears greyish-white and the boiled test sample is a clear yellow, owing to the presence of ferric sulphate. The precipitation of the selenium as the metal is accomplished in the same way as when permanganate is used as the oxidiser, but owing to the fact that chlorate oxidation produces only the slightest amount of selenic acid, more selenium can be recovered, and an overall yield of 90 per cent. is usual. This, added to the advantage in price of sodium chlorate over potassium permanganate, makes the process considerably more profitable.

Recently it has been found that sulphur trioxide is the most suitable and least costly oxidising agent for the extraction of selenium. The sludge is spread over the bottom of a capacious lead-lined digester, oleum containing 20 per cent. of SO_3 is added, and the mixture warmed. Under these circumstances, the reaction between SeO_2 and SO_3 is reversible, and in the presence of an excess of the sulphur trioxide selenium can be oxidised to the dioxide. The sulphur dioxide evolved is led back to the lead chambers, and a little oleum containing 80 per cent. of SO_3 is added from time to time until the whole of the selenium, as judged by the whitish-grey appearance of the suspended matter, has gone into solution. The cooled mixture is then diluted with 1 per cent. sulphuric acid, filtered at the press, cooled, allowed to settle for 24 hours, and re-filtered. The selenium may then be removed as the metal by the passage of sulphur dioxide. In this process no selenic acid is formed, so that high overall yields are possible.

Purification of Selenium

The purity of selenium prepared by these methods varies between fairly wide limits. If the utmost care is taken, the chlorate process will give a metal containing 95 per cent. of selenium, but in the trioxide process the purity is about 85 per cent. A typical analysis of the product of the permanganate process gave:—

Selenium	82.6 per cent.
Lead	5.6 " "
Sulphate (SO_4)	6.0 " "
Calcium (CaO)	5.0 " "
$\text{MnO} + \text{Fe}_2\text{O}_3$	0.4 " "
Copper	Trace

The only satisfactory method of purification is by distillation. Since selenium boils at about 680° C., the water and any free sulphuric acid distil over long before the selenium, and the other impurities remain behind. A special form of distillation apparatus is used (shown diagrammatically in Fig. 3), in which the receiver is kept hot by the flue gases, so that the selenium may be collected in the molten state and cast into ingots. The material of the still is of importance. Substances such as porcelain and fused quartz are suitable, and will withstand the temperature used (800-900° C.), but are fragile and expensive to replace. On the other hand, nearly all pure metals react with selenium at a red heat; an exception is found in cast iron containing about 5-6 per cent. of silicon. Although hard to work, this material gives the best results in practice. The retort is cylindrical, about 2 ft. in diameter and 4 ft. high, and furnished with a round bottom, and an insert tube for the pyrometer (A). The stillhead is furnished with the usual type of manhole lid (B), and communicates with the side arm of the ferrosilicon Y-piece (C). This latter is attached to the body of the condenser and is also furnished with a lid, through which obstructions can be removed, should

solidification in the receiver inadvertently take place. The receiver is provided with a pyrometer, and by adjustment of dampers, is kept at a temperature of about 360°C . The charge consists of about half-a-hundredweight of crude

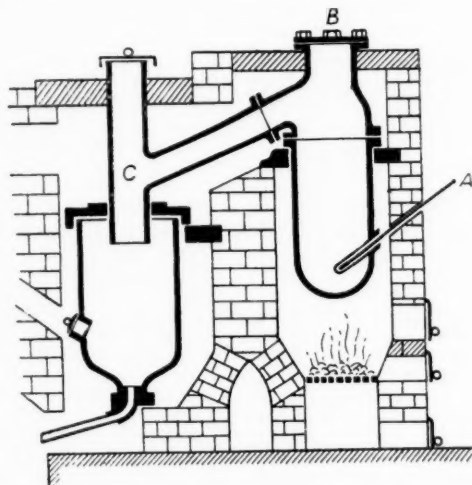


FIG. 3. DISTILLATION APPARATUS FOR SELENIUM.

selenium, which is brought to the boiling point in about three hours, during which the water and sulphuric acid distil off. During the next nine hours the selenium distils over, is condensed to the liquid state, and cast into long thin ingots. A fair proportion of the selenium remains behind in the residue and refuses to distil, even when the temperature of the retort is raised to 1000°C . The composition of a typical retort residue is given by the following:

Selenium	38.65 per cent.
Lead	33.32 " "
Iron	9.31 " "
SO_3	5.04 " "
S	1.69 " "
$\text{Al}_2\text{O}_3 + \text{Mn}_2\text{O}_4$	0.73 " "
Silica, etc.	11 " "

The extraordinary fact about the distillation of selenium is that the yield is influenced enormously by the nature of the impurities. Thus in the case of the above specimen, where the impurities are mainly lead sulphate and oxide, only about

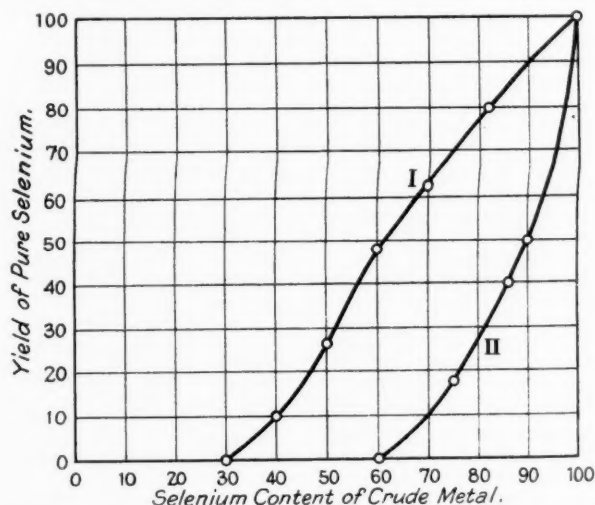


FIG. 4.—YIELD OF PURE SELENIUM. I. IMPURITIES MAINLY LEAD. II. IMPURITIES MAINLY CALCIUM SULPHATE.

30 per cent. of the selenium remains behind; if the impurities are mainly calcium sulphate much more selenium is retained. This is shown graphically in Fig. 4. It is for this reason that perfect clarification of the liquors from suspended calcium sulphate is insisted upon. The redistilled selenium is usually 99.5 per cent. pure. It contains a trace of iron and of sulphur, but is usually quite free from tellurium. The conversion of the crude selenium into sodium selenite is a comparatively simple matter. The crude metal is warmed with nitric acid (S. G. 1.2) until oxidation of the selenium to selenious acid is complete. The solution is then very gently evaporated to dryness, and the selenious acid extracted from the insoluble matter (lead and calcium sulphate) with warm water, neutralised with caustic soda solution, and evaporated to dryness.

Uses of Selenium

Apart from the use of selenium in the construction of instruments in which the photo-sensitive properties of this element are exploited, but which do not utilise more than a minute fraction of the output of selenium, there are several uses which make selenium a valuable substance in industry. An example of this is its use in flame-proofing of electric cables. The cables behind the switchboards of generating and distributing stations are apt to accumulate dust, and in view of the heavy currents carried, it is not surprising that occasionally sufficient "shorting" occurs to set fire to parts of the cable coverings. Unless this is immediately checked there is considerable risk of the whole board being burnt out and the service dislocated. It has been found, however, that cables treated with a thin layer of metallic selenium are flameproof to a remarkable extent, and that one part of selenium will flameproof 3.6 parts of cotton or 10 parts of rubber to such an extent that if the treated cable be held in the flame of a burner until the characteristic livid blue flame of burning selenium is observed, the burning material is immediately extinguished on removal from the flame. It has been found that one pound of selenium will protect a mile of ordinary-sized cotton-covered wire in this way, and the resulting material has been successfully applied to the construction of flameproof switchboards. Curiously enough, tellurium is without this property.

Selenium cannot efficiently take the place of sulphur in the curing of rubber, and so far attempts to apply it in this way, or in the form of its compounds in the acceleration of the vulcanisation of rubber, have been unsuccessful.

The principal use of selenium and its compounds is in the glass industry and for the production of ruby glazes in the ceramic industries. Its use in the glass industry is to remove the colour from glass in which traces of iron are present. Almost any glass prepared from ordinary materials has a greenish tint, due to the small amount of iron present in it. It was at one time usual to correct this tint by the addition of manganese dioxide, but since the introduction of tank furnaces and of mechanical blowing and casting machines, it has been found that manganese is not successful in the presence of a reducing atmosphere. Selenium, however, decolorises excellently under these circumstances, and is added in the proportion of about $\frac{1}{2}$ oz. to 1,000 lb. of sand, together with $\frac{1}{4}$ th to $\frac{1}{2}$ th of its weight of cobalt oxide, to correct the slight muddiness which remains after selenium decolorisation. It is not possible to correct the colour of glass which contains more than one part of iron per 1,000, since a muddiness develops. It has been found that sodium selenite is far more efficacious as a decoloriser than metallic selenium itself, even when allowance is made for the selenium lost by volatilisation. If too much selenium is added a yellow or ruby colour may develop. This phenomenon is made use of in the preparation of ruby glass. The "mix" for one such glass is made up thus:—

Sand	53.7 per cent.
Potash	15.25 " "
Soda ash	16.25 " "
Zinc oxide	11.37 " "
Cadmium sulphate ..	0.81 " "
Selenium	0.81 " "
Borax	0.81 " "

This mixture is charged in 30 lb. batches into a monkey pot, and treated by an elaborate series of heatings and coolings, which appear to be necessary for the development of the colour.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Institute of Metals: Student Membership

In order to encourage metallurgical and engineering students under the age of 23, and those of a similar age working under persons who are qualified for membership of the Institute, to take an interest in their professional society, and to obtain the literature which they require in their studies, there exists a class of member of the Institute of Metals which is known as "Student" member. "Student" members of the Institute of Metals have all the advantages of full members, with the exception that they have no voting power. They receive, free, the two bound volumes of the *Journal* which are issued annually, and all the other publications of the Institute. They are able to borrow any book contained in the library, and to obtain many other advantages which the full member of the Institute has. "Student" members pay an annual subscription of only £1 is. (instead of £3 3s. paid by a full member) and an entrance fee of £1 is. (instead of £2 2s. paid by a full member).

The council very much hopes that a greater number of persons who are qualified for "Student" membership will join the Institute in the coming year. At the present moment the majority of the "Student" members come from the metallurgical and engineering departments of the Universities. It is hoped that those studying in the technical colleges and others working in the metallurgical and engineering establishments will also take advantage of this low subscription and join the Institute. Application forms for "Student" membership can be obtained from the secretary, The Institute of Metals, 36, Victoria Street, London, S.W.1. Elections take place on April 11 next. The subscriptions of "Student" members whose forms go forward at these elections will cover them until June 30, 1929, and in addition to the usual two bound volumes of the *Journal* received by them in return for their annual subscription, they will receive a copy of the *Journal* which is to be issued in June next.

Heat-Resisting Alloys

THE paper read by Mr. T. Henry Turner on the above subject before the Co-ordinated Societies at Birmingham sums up admirably the situation in regard to these increasingly important alloys. For firebars, cylinders, etc., cast iron gives trouble owing to its habit of growth, and, on the other hand, when alloyed with chromium in quantities sufficient to make it really heat-resisting, not only becomes too expensive for ordinary use, but too hard as well, and therefore unworkable. He describes, however, two new alloys: "Nicroth," a white cast-iron containing chromium, but enough nickel as well, to make it reasonably machinable; and an alloy developed by the International Nickel Co., which is a so-called "Monel" cast iron, containing approximately 13 per cent. of nickel and 6 per cent. of copper. This material is likewise machinable. With these and the many admirable steels of the stainless class, both heat- and corrosion-resisting, the modern engineer's exigent demands are, to some extent, being met, but a lot of work is still required if the metallurgist is to keep pace with engineering requirements. It is particularly to be desired that some really heat- and corrosion-resisting light alloys should be discovered, adequately to serve the needs of high-temperature aeronautical engineering.

Cupro-Nickel

AMONGST the numerous and interesting non-ferrous metal exhibits at the Birmingham Section of the British Industries Fair, few excited more attention than the cupro-nickel alloys, now so largely used for condenser tubes, and allied purposes. Copper and nickel, being soluble in one another, form a continuous series of solid solutions, hence the range of alloys produced vary greatly in their properties. For condenser tubes the 80:20 and the 70:30 alloys are preferred, but they have to be prepared with special skill and experience, and every source of contamination scrupulously avoided. Their heat treatment, moreover, requires great care. Properly prepared, their corrosion-resistance is remarkably high, and besides being used for marine purposes, they are being employed in many other directions, and have given satisfaction in sugar refineries, where the service conditions are often very severe.

They are also used to an increasing extent for bath and lavatory fittings, and for ornamental uses. They have a beautiful silvery lustre, and take a high polish.

Properties of Wrought Iron

It is a metallurgical commonplace that pure metals corrode less than impure ones, exception being duly made for the deliberate addition, in certain alloys, of a more "noble" to a less "noble" metal for the express purpose of diminishing corrosion in the main—and less "noble"—metal of the two. Stainless steels and cupro-nickels stand in a class by themselves. Whether the presence of copper in iron or steel accelerates or retards corrosion is still a moot point: in one very pure variety of iron the greatest care is taken to select pig iron and scrap that does not contain this metal. These considerations apart, there is a very wide consensus of opinion, supported by very numerous examples, that wrought iron is less subject to ordinary corroding influences, the action of moist air, water, etc., than mild steel, and a good many specifications take this into explicit consideration. It is, however, essential that the wrought iron should be what it purports to be, and not something masquerading under that name. Both British and American specifications frequently stipulate that wrought iron is to be free from any admixture of steel. This stipulation was laid down on empirical grounds, and in connection with such considerations as strength, toughness, impact resistance, and kindred qualities which, apart from corrosion-resistance, made good wrought iron a highly valued material.

Admixtures of Steel

A FEW years ago at a conference of gas engineers, those empirical considerations were strikingly established as correct by actual experiments. Wrought iron with admixtures of steel behaved very badly when subjected to the action of distilled water, or of syphon liquor, as compared with genuine wrought iron. Here, again, a pure iron of the "Armco" ingot iron type showed itself superior to wrought iron, but wrought iron showed itself superior to mild steel. History is about to repeat itself, and some very remarkable results will shortly be forthcoming in this connection. In the meantime it is to be observed that the findings of the conference referred to comprised a statement to the effect that post-war wrought iron compared very unfavourably with pre-war wrought iron. Beyond the suspicion that some steel admixture may be at the bottom of this complaint, there would seem to be no very good explanation of this unfavourable comparison.

Jeopardising an Industry

THE reputation of wrought iron is not one to be lightly jeopardised. The industry is a fairly old one—puddling was invented by Cort nearly 150 years ago—and during the middle and latter part of the nineteenth century was an exceedingly prosperous one. It appears to have fallen on evil days. A wrought iron works in Yorkshire has, within the last few weeks, been acquired for the purpose of dismantling. The plant comprised 22 puddling furnaces. Staffordshire makers are making every endeavour to revive interest in wrought iron, yet there are evidences on all hands that the industry is dwindling. It has, of course, a powerful rival in "Armco" ingot iron, but that is hardly enough to explain the passing of wrought iron altogether. Another needs to be sought. Is it that the reputation of wrought iron has been irreparably injured by the sale of spurious admixtures containing steel? If so, and the innocent are suffering for the faults of the guilty, it is time that they made the most strenuous efforts to revive the industry, by pledging themselves to make and sell nothing but the genuine article, and repudiating all connection with the inferior "post-war" product which has done so much harm to a deserving industry.

Commercially Pure Iron

THE material which is competing so strongly with wrought iron is, so far as its manufacture is concerned, as much a British industry as the manufacture of puddled iron, seeing that it is made in at least two large British works, and worked up in a number of others. There is, however, still a good deal of misconception regarding it, as well as regarding some of its

properties. One of the most remarkable of these has been well brought out in a paper read by Mr. Reid L. Kenyon, before the American Society of Steel Treathers. It is the relationship of its "endurance" to its ultimate strength. It was Moore and Kommers who were the first to point out that the endurance limit of "Armco" ingot iron was higher than its elastic limit under static test. Gough, in his "Fatigue of Metals," also emphasises this property, although in other words, since he refers to its fatigue range exceeding its primitive yield point. The real point in all this is clearly indicated by Mr. Kenyon. "Armco" ingot iron members, properly designed to resist given static stresses, will resist vibrational stresses of corresponding severity without failure, which is more than any other ferrous material can do. There is thus no margin of safety to be taken care of: a properly designed part will stand up to its work without any unnecessary additional weight being used as a safety factor. In other words it will not fail suddenly from "mysterious" and "chance" causes.

Broughton Copper Works

FOLLOWING upon the important deal announced recently, the prospectus of Broughton Copper Works (1928), Ltd., was issued on Wednesday. The capital is £525,000 in 425,000 $7\frac{1}{2}$ per cent. cumulative preference shares of £1 each, and 2,000,000 ordinary shares of 1s. each. There are no debentures. The public issue consisted of all the preference shares at par and 1,275,000 of the ordinary shares at 2s. each. Applicants were offered the rights of three ordinary to one preference. The new company takes over the business and goodwill of the Broughton Copper Co., Ltd., and of John Bibby, Sons, and Co. (Garston), Ltd., the well-known copper smelters and manufacturers. These concerns were established as far back as 1864 and 1862 respectively, and since 1907 the two businesses have been closely associated. The customers include the British and Foreign navies, the War Office, the Air Ministry, Home and Colonial Government Departments, Foreign Governments, and the leading railway companies at home and abroad.

Magnetic Alloys: "Mumetal" and "Rhometal"

"MUMETAL," so named because it is an alloy with remarkable magnetic properties, has an initial permeability of the order of 7,000 to 10,000, with very low hysteresis losses—about one-tenth that of the best Swedish iron—and in addition has very high electrical resistance. These unique properties have been utilised in the manufacture of continuously loaded high-speed

high frequencies. These alloys are manufactured by the Telegraph Construction and Maintenance Co., Ltd., of Wharf Road, City Road, London. These special magnetic alloys require heat treatment in order to develop their properties



MICROPHOTOGRAPH OF RHOMETAL (HEAT TREATED STAMPING).

fully. This process is carried out as near the final manufacturing operation as possible, because the magnetic properties are likely to be damaged by such work as punching, stamping, bending, etc. The Telegraph Construction and Maintenance Co. undertake the heat treatment process for their clients, and give advice and technical assistance to any users of their special alloys.

A Book on Protective Coatings

IN view of the great attention which is now being paid to the prevention of corrosion, the appearance of a book on *Protective Metallic Coatings*, by Henry S. Rawdon, of the United States Bureau of Standards, is peculiarly opportune. The book (pp. 277, \$5.50) is one of the American Chemical Society's Monograph Series, published by the Chemical Catalog Co., of New York. In preparing this monograph, the author has attempted, first of all, to give a discussion of those characteristics and properties of the various types of metallic coatings which determine the usefulness of such coatings as well as their limitations.

After an introductory chapter, there is a section, divided into four chapters, dealing with coating methods. The chapter-headings in this section are as follows: coating methods depending on the alloying of coating and base; electroplating; metal spraying and sprayed-metal coatings; and the chemical treatment of metallic surfaces. The next section of the book (divided into seven chapters) deals with commercial metallic coatings, the special subjects treated being zinc coating by the hot-dipping or galvanizing process; zinc-coating by cementation, electroplating and other methods, with a comparison of coatings made by various methods; tin coatings; coatings of copper, nickel, chromium and cobalt; coatings of lead, cadmium, and aluminium; gold and silver coatings; and miscellaneous finishes. The last section of the book deals with testing methods (including mechanical, chemical, accelerated corrosion, and exposure tests, and quantitative methods). There is a very fine bibliography (30 pages) of the literature of the sections, conveniently divided into a number of sections, to which reference is made throughout the book. Author and subject indexes are provided. It is hardly necessary to say that this book will be of great value to the metallurgist, the chemist, the engineer, and to all others interested in metal coatings and the prevention of corrosion.



MICROPHOTOGRAPH OF MUMETAL (HEAT TREATED).

submarine telegraph cables. "Rhometal" is an alloy characterised by very high electrical resistance. Its high resistance enables it to be used in alternating current circuits at very

Trade, Commerce, Finance : The Month in Review

From Our Market Correspondent

THE iron and steel trade has not been entirely featureless during the month of February; indeed, there have been developments which have aroused a feeling of optimism in some quarters, although in reality there is not much ground to be optimistic. On February 15, the various associations of steel makers met in London and decided that on and from that date the prices of all material under the control of the associations should be advanced 5s. per ton, and that the same advance should apply to the rebate granted to those consumers who had joined in the rebate scheme which was put into operation in September last year. To such consumers the net price remains as it was before, and they have now an advantage of 10s. per ton in the price of plates, bars, and sections produced by the associated makers, as compared with those firms who have not taken part in the scheme.

Continental Prices

It is probable that the reason for this move is to be found in the change in the Continental conditions which has taken place recently. There has been a gradual all-round advance in Continental prices, amounting to about 10s. per ton, since the latter part of 1927. Steel bars are now quoted about £6 10s., and steel plates £7 5s. for Thomas quality, and £7 15s. for Siemens steel. In addition to this advance in price, there is a marked increase in the length of time required for delivery. It is reported that many of the Continental works have booked so well ahead that they have several months' work on the books. There must be some truth in this, as it is now almost impossible to get a promise of reasonable delivery from abroad, either for finished steel or for billets. The result is that consumers are turning to the home works in cases where prompt delivery is required, although as yet the actual business has not increased. The same conditions apply to the export market, for which a somewhat better demand is being experienced.

It is in such conditions that the steel makers in this country have announced the advance in prices and rebate, the purpose evidently being to secure a still larger share of the work which has previously gone abroad. It is the general opinion that the rebate scheme so far has not been particularly effective in this object, the amount of the rebate being too small in comparison with the large margin between the Continental and home prices. This position is not altered by the advance just announced, as the net price is not reduced, and the stiffening of the Continental prices may be only temporary. Nevertheless, the 10s. rebate is an important consideration, and should have an influence on those buyers who find that they have not only to pay more for foreign steel, but to wait an indefinite time for delivery.

Effect of New Prices

Meanwhile, the new prices are in force, and as far as the controlled materials are concerned the steel makers must benefit to some extent. But this benefit seems likely to be offset by the increased competition for the uncontrolled materials. It is a pity that the avowed purpose of the control—to prevent prices from being cut to an extreme degree—cannot be realised for all classes of steel. It is rather an anomaly that the same steel makers who are combined together to maintain the prices of steel plates, sections, and large bars, are engaged in the most intense competition with one another for those classes of steel outside the control of the associations. This competition has gone beyond the ordinary limits, and is regulated not so much by the cost of manufacture as by the desire or, more correctly speaking, the stern necessity of getting more orders to keep the mills running.

There is little method in the way this contest is carried on. There is no fixed basis, and even the extras are sacrificed in order to achieve the purpose of cutting the other fellow out. There is an astonishing amount of money lost to the steel makers by this unnecessary cutting of prices. It is not clear how this competition can be avoided in the absence of a controlling body which embraces the whole of the steel makers in the country, but one would like to see a more consistent attitude among the makers. For instance, a 3 in. round bar, which comes within the associated limits, must be quoted at

£8 17s. 6d., less, of course, the rebate of 10s., whereas an order for 2½ in. round can be placed at £7 5s. with the same steel maker who must charge the higher price for the 3 in.

Condition of the Industry

Not only in small bars, but in billets, thin sheets, and in special qualities of steel, is this competition rampant; and in spite of it, the shortage of orders is still the main concern of those who have the responsibility of running the works. And the fact that it exists is a more reliable indication of the real condition of the industry than the semi-optimistic reports which are based on superficial movements. There is still no real improvement in trade. Account must be taken of the effect which the announcement of the advance in prices would have on the market; also of the effect of the changed Continental conditions, and therein lies the basis for the more cheerful tone which some districts have reported.

So long as there is not enough work to keep all the plants busy, the increased activity of one generally means a shortage for another. Particularly is this so in steel plates. Since the entry on the market of such plants as that at Appleby, there has been a shrinkage in the plate orders for the previously existing mills; and since the new mills started, the general shortage of plate orders has been more acute than ever. The problem generally has to be solved as far as possible by making full use of whatever natural advantages the individual works have to offer. As far as plates and sections are concerned, no one works can offer any inducement in price against the other makers, and in this particular line as in all other products a preference can only be secured by means of the advantage offered in either quality or service or both. Good salesmanship will make the best use of these aids and so secure a larger proportion of the available business.

An Analogy from the Coal Industry

In this connection, the organisations which have been established in the coal trade, for the restriction of output and for central control of sales, are of interest. We may have to come to similar arrangements in the steel trade. As mentioned in a previous report, something of the kind is already under consideration for the export trade, and if that should go through successfully, it is not outside the bounds of possibility that the scheme may be extended. There is certainly evidence of the tightening of the control of the associations over the individual members, and the unhappy condition of the steel industry may make an extension of this control an urgent necessity.

There is little improvement in the coal trade, and the result is seen in the shrinkage of orders from the collieries to the steel works. Rails are not being ordered as freely as formerly, and only work that is urgently necessary is given out. The motor trade, also, is not so brisk as it might be, and orders have fallen off in consequence. The pig iron market remains dull. There is little new business passing, and makers find it difficult to obtain specifications. There is no further official reduction in price, although individual makers are sometimes willing to shade a little in their eagerness to secure orders. There is no change to report in hematite. There is still talk of an advance in price, but the makers seem afraid to make this move, as there is not sufficient demand to warrant it.

Steel Prices

In finished steel, business is still restricted to the satisfaction of current requirements, although the announcement of the advance of 5s. seemed to bring out a little more inquiry. The general complaint from the works is that the orders are not sufficient to keep the mills in full operation. The official prices are now £8 12s. 6d. for plates delivered into the Midlands, or £8 7s. 6d. on the North East Coast, and £7 17s. 6d. for sections, these prices being subject to the rebate of 10s. Small bars are quoted from £7 5s. to £7 10s., and boiler plates remain at £9 15s. to £10.

The output of pig iron during January was 560,000 tons, which is practically the same as the December output. There is a decrease of one in the number of furnaces in blast. The output of steel was 626,200 tons, compared with 604,900 tons in December.

Some Inventions of the Month

By Our Patents Correspondent

*Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.***Alloys**

ACCORDING to a patent by J. Stone and Co., Ltd., Deptford, and H. J. Maybrey, aluminium alloys, particularly those containing silicon, are improved by an addition of a product which probably consists chiefly of aluminium boride, and which is obtained by heating boron or a boron compound with aluminium powder and a small amount of an oxidising agent. According to an example, a mixture of borax, aluminium powder, and potassium chlorate is heated at 900° C. until reaction has occurred, and the molten aluminium-silicon alloy is added thereto. See Patent No. 283,760, having the date February 26, 1927.

Colonel R. K. Hezlet and R. Genders, of the Research Department, Woolwich Arsenal, find that the so-called "nickel silver" alloys consisting of copper, nickel and zinc can be improved in certain respects by an addition of up to 2.5 per cent. of aluminium when the combined nickel content does not exceed 15 per cent., and of 0.2 to 0.3 per cent. when the nickel content is 20 per cent. and the copper content 20 per cent. The alloys have improved colour and mechanical properties and show less tendency to corrode. In casting the alloys, it is necessary to pour in such a way that the cross-section of the stream of molten metal approaches that of the mould; otherwise, globules of metal which may separate oxidise rapidly and fail to redissolve in the molten metal. See Patent No. 283,994, having the date October 16, 1926.

An alloy containing manganese, aluminium, magnesium, silicon, nickel, and iron, is prepared for addition in amounts up to 10 per cent. to copper alloys such as brass or bronze waste. See Patent Application 282,095, by E. Manos, Geneva, having the International Convention date December 11, 1926. In Patent Application 282,096, having the same date, the same inventor describes white non-oxidisable alloys of the "nickel-silver" type, which consist principally of copper, nickel, and zinc, together with small amounts of aluminium, iron, silicon, and magnesium, with or without manganese and chromium.

Iron

ACCORDING to H. J. Van Royen, of Hoerde, Germany, iron for steel manufacture is purified by decarburising by blowing in the usual way, and is then deoxidised by means of a reducing non-carbonising gas which does not change in volume when oxidised, such as a mixture of carbon dioxide, carbon monoxide, and nitrogen, or a mixture of sulphurous acid and nitrogen. The subsequent carburising of the purified iron may be effected by passing suitable vapours or gases such as gaseous saturated hydrocarbons through it. See Patent Applications 282,365 and 282,366, having the International Convention dates December 14 and 15, 1926.

Stainless irons of low carbon content and a chromium content of 12-18 per cent. are prepared by first adding a high-carbon ferro-chrome to the iron bath, and eliminating carbon by addition of iron ore, or preferably iron roll scale, during which treatment much of the chromium passes into the slag. The chromium is then reduced from the slag by addition of a non-carbonaceous reducing agent, such as ferro-silicon, and a base such as lime. A final adjustment of the chromium content or addition of other elements may then be made. See Patent Application 282,387, by A. L. Field, White Plains, New York, having the International Convention date December 18, 1926.

A process for the production of malleable iron castings is described by the National Malleable and Steel Castings Co., Cleveland, Ohio, U.S.A. The castings are quenched from a temperature above the critical temperature in such a manner that the rate of cooling is at least 10° F. per second; they are then heated to above the critical point (1,650° F.) for sufficient time to decompose the cementite, cooled below the critical temperature, and then maintained thus for 30 hours and cooled. See Patent Application 282,671, having the International Convention date December 23, 1926.

J. W. Hornsey, Norton by Sheffield, and H. E. Coley, Paper

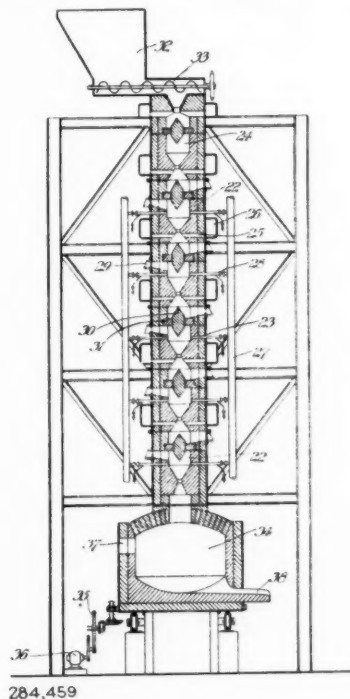
Buildings, Temple, London, have described a method for the direct production of iron from its ores without smelting. The iron ore is preheated in the first of a series of rotary, slightly inclined chambers and passes into the second without access of air, where it is treated with carbonaceous material, containing hydrocarbons; the latter are quickly released, become cracked, and the cracking products and carbon effect reduction of the ore to spongy iron. The second chamber is heated to 850-1,100° C. by the introduction, at the lower end, of powdered fuel with just sufficient air for combustion. The reduced material is cooled in a third cylinder of the series, air still being excluded. See Patent No. 284,040, having the date July 26, 1926.

Extracting Metals

METALS such as zinc are extracted from sulphide ores by heating the ore with iron in a slag bath in an electric furnace. The iron combines with the sulphur and the metal is distilled if volatile. Preferably the mixture is fed continuously on to the surface of slag so that a comparatively thin layer is maintained thereon. The slag obtained contains most of the iron, and may be roasted and reduced for further use. See Patent Application 280,540, by E. G. T. Gustafsson, having the International Convention date November 11, 1926.

Furnaces

A FURNACE for the treatment of finely-divided ores such as iron sand consists of a vertical chamber, through which the material falls, heated by gas jets at a number of points, and provided with a number of centrally disposed baffles. The figure shows one form of the furnace. Material is fed in from the hopper 32 by the conveyor 33, and passes downwards through the series of chambers 22, which are tapered top and bottom and which contain double conical baffles 30 supported by elements 31. Gas jets 23, supplied from mains 27 are



provided for each chamber with the exception of the uppermost, 24, which serves as a preheating chamber and is heated by products of combustion from the lower chambers. The furnace is also provided with outlets 25 for combustion gases, and inspection windows 29. The treated material is delivered into a crucible 34, which has an outlet 38, for molten metal, and an outlet, 37, for slag. The temperature may be varied as desired from point to point by regulation of the heating jets. See Patent Specification 284,459, by D. Croese, of Amsterdam, Holland, having the date January 20, 1927.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—Alloys of beryllium with copper, nickel, cobalt and iron. G. Masing. *Zeitschrift für Metallkunde*, January, pp. 19-21 (in German).

Compensation phenomena in beryllium-copper alloys. O. Dahl. *Zeitschrift für Metallkunde*, January, pp. 22-24 (in German).

ALLOY STEELS.—Physical properties of several chromium-aluminium and chromium-aluminium-nickel steels. V. O. Homerberg and I. N. Zavarine. *Trans. Amer. Soc. Steel Treating*, February, pp. 297-304. The affinity of aluminium for nitrogen in the ammonia case-hardening process has resulted in the manufacture of special alloy steels containing aluminium, together with chromium or with chromium and nickel. The action of ammonia gas on these steels at a comparatively low temperature results in the production of a very hard surface without deformation of the material and without any subsequent heat treatment. The present paper gives the results of an investigation into the properties of three steels.

CORROSION.—New methods of corrosion research. J. Czochralski and E. Schmid. *Zeitschrift für Metallkunde*, January, pp. 1-7 (in German).

ELECTROPLATING.—Cadmium as used by the plating industry. H. S. Lukens. *Brass World*, January, pp. 16-17.

Nickel anodes. G. B. Hogaboom. *Brass World*, January, pp. 18-19. Gives comparisons of cast and rolled anodes.

The relation of polishing to chromium plating. P. W. Ellwanger. *Metal Industry* (New York), February, pp. 77-78. A plea for better polishing.

GENERAL.—Action of pigments in metal primers. E. J. Probeck and H. W. Battle. *Industrial and Engineering Chem.*, February 1, p. 197.

The growth of industrial cleaning. I. D. J. Benoliel. *Metal Industry* (New York), February, pp. 79-80. The history, chemistry, and mechanics of metal cleaners.

The use of lead in engineering practice. I. O. W. Ellis. *Brass World*, January, pp. 11-13. Deals with the alloys, properties and practical applications of lead.

Bursting pressures of brass and copper pipes. W. G. Schneider. *Brass World*, January, p. 9.

The electrical precipitation of metal-containing dusts from industrial gases. W. Deutsch. *Zeitschrift für Metallkunde*, January, pp. 25-27 (in German). Discusses the losses of the foundry industry through the metallic dusts in the industrial gases. Gives details of electrical gas purification, of its theory, and of the further handling of the recovered dust. Deals with electrical dust-precipitation in brass, copper, zinc, aluminium, and silver works.

IRON AND STEEL.—The transformation of austenite into martensite by liquid air. J. Schroeter. *Zeitschrift für anorganische Chem.*, Vol. 169, Parts 1-3, January 25, pp. 157-160 (in German).

Manganese in steel and pig iron. L. E. Stout and G. E. Whitaker. *Industrial and Engineering Chem.*, February 1, pp. 210-212. This paper gives (1) a method for the preparation of standard vanadyl sulphate solution from ammonium metavanadate; (2) a vanadate method for the determination of the manganese content of steel and pig-iron; (3) the effect of silver sulphate concentration on the rate of oxidation of manganese from manganous nitrate to permanganic acid.

Hardening by reheating after cold working. M. A. Grossmann and C. C. Snyder. *Trans. Amer. Soc. Steel Treating*, February, pp. 201-220, 281. A theory is advanced to explain the phenomenon of the hardening of cold-worked steel by reheating at low temperatures. The theory is connected with a thin layer of "interblock" material, which increases gradually in thickness as the reheating temperature is raised, reaching a maximum effective thickness at approximately 600°F.

Evaluating quality in heat-treated high speed steel by means of the milling cutter. J. B. Mudge and F. E. Cooney. *Trans. Amer. Soc. Steel Treating*, February, pp. 221-239.

Armco ingot iron. R. L. Kenyon. *Trans. Amer. Soc. Steel Treating*, February, pp. 240-269. This paper is an attempt to compile and co-ordinate the vast amount of information which has accumulated with regard to Armco ingot iron. It also presents numerous data from unpublished work of the research Department of the American Rolling Mill Co. Details include chemical analysis, microstructure after various treatments, and the effect of mechanical work and heat treatment on its physical properties.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case, the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

BUTTERLEY CO., LTD., coal and iron masters.—Registered February 7, £150,000 debentures, balance of £500,000; general charge. (NOTE.—The return registered September 29, 1926, showing an issue of £50,000 debentures, dated September 18, 1926, was in error, no issue having been made on that date.) *£110,000. July 12, 1927.

EBBW VALE STEEL, IRON AND COAL CO., LTD.—Registered January 12, charge, to bank; charged on certain railway wagons. *£1,511,275. July 12, 1927.

ELBA TINPLATE CO., LTD. (late GLAMORGAN TIN-PLATE CO., LTD.), Swansea.—Registered January 30, £30,000 debentures, part of £200,000; general charge. *£170,000. November 3, 1927.

FARNLEY IRON CO. (FIRECLAY WORKS), LTD.—Registered February 15, by order on terms, £70,000 debentures, to Farnley Iron Co., Ltd., Farnley; charged on property at Leeds, also general charge.

FEDERATION TIN MINES, LTD., London, E.C.—Registered February 14, £12,000 debentures; general charge.

MONDEGO TIN DREDGING CO., LTD., London, E.C.—Registered February 2, £2,000 debentures, part of £10,000; general charge. *£56,500. December 31, 1927.

PEASE AND PARTNERS, LTD., Darlington, coal and iron masters.—Registered January 31, £80,000 debentures, to bank; general charge (subject to prior charge). *£1,743,761. June 7, 1927.

YORKSHIRE IRON AND COAL CO., LTD., Leeds.—Registered January 20, £13,000 mortgage, to J. L. Booth, Lonsborough Park, Market Weighton, and others; charged on properties at West Ardsley, etc. *£110,307 1s. 2d. June 10, 1927.

Satisfactions

BUTTERWORTH AND DICKINSON, LTD., Burnley, ironfounders.—Satisfaction registered February 18, £25,000, registered March 29, 1902.

WARREN (SAMUEL), LTD., Sheffield, iron and steel manufacturers.—Satisfaction registered February 9, £8,500, part of amount registered March 24, 1921.

YORKSHIRE IRON AND COAL CO., LTD., Leeds.—Satisfaction registered February 1, £13,000, part of amount registered July 5, 1901.

Resistant Steels at the B.I.F.

At the London section of the British Industries Fair, which closed on Friday, displays of various kinds of steel were made by Hadfields, Ltd., and Thos. Firth and Sons, Ltd., both of Sheffield. Hadfields, Ltd., concentrated mainly on their Era C.R. corrosion resisting steel and their Era H.R. heat resisting steel. A new application of the corrosion resisting steel is in the manufacture of decorative ware, where it gives very beautiful and lasting results. Thos. Firth and Sons, Ltd., showed their new heat resisting steel, Firth H.R. Crown, as well as their well-known Staybrite steel.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

The Extraction and Utilisation of Molybdenum.—(I)

By G. Malcolm Dyson, Ph.D., A.I.C.

Molybdenum, in addition to its use as a "scavenger," finds growing application in the production of high-speed tool steels. The following is the first part of an article giving a compact account of the production and use of the element.

MOLYBDENUM must be counted among the rarer elements, but in spite of its comparatively meagre, although wide, distribution in nature, it has risen to a place of no inconsiderable importance, not only in metallurgical practice (where its alloys with iron are valued for the production of high speed steel), but also in the general chemical and ceramic industries, where the molybdates find extensive employment. Historically, our knowledge of this element dates from the discovery of the sulphide by the indefatigable Scheele, up to which time native molybdenite had been confused with graphite, to which it bears a superficial resemblance. Scheele recognised molybdenite to be "a compound of sulphur with a new acid—the acid of molybdenum." This mineral, molybdenite, the sulphide, is the principal source of the element and can readily be distinguished from graphite. In the first place the density of graphite seldom exceeds 2, whilst that of molybdenite varies between 4.4 and 4.8; in addition, the molybdenum ore is usually met with in quite distinct hexagonal tabular crystals which have a green streak; that of graphite is black.

Molybdenite is usually associated with the pegmatites or tin-bearing ores, and also with zirconiferous syenites, and is often found disseminated throughout compact quartz. Its complete separation from gangue is, therefore, very seldom complete, a fact which is clearly shown in the two analyses which follow, the first being a selected pure crystalline specimen and the second a random sample containing gangue. Both are from the same vein of Australian molybdenite.

	I. Selected Crystalline Molybdenite.	II. Random Sample with Gangue.
Molybdenum sulphide	97.7	56.21
Arsenic sulphide	0.52	—
Copper sulphide	0.64	1.58
Silica	0.96	29.24
Alumina	0.10	3.00
Phosphate (P ₂ O ₅)	0.07	0.73

The only other molybdenum mineral of outstanding importance is wulfenite, a lead molybdate approximating to the formula PbMoO₄. Many deposits of this mineral, which occurs in octahedral crystals, are known—those at Bleiberg and Aunaberg on the Continent, at Southampton, Mass., and at the Mammoth mine, Arizona, being the best known. An average analysis of wulfenite shows: molybdic anhydride 28.9 per cent., phosphoric anhydride 2.8 per cent., lead 53.6 per cent., and gangue 12.8 per cent. Other molybdenum minerals include:—

Molybdite (Molybdenum ochre)....	3MoO ₃ .Fe ₂ O ₃ .7½H ₂ O
Powellite	CaMoO ₄
Ilsemanite	Blue molybdenum oxide
Achrematite	Pb(Mo.As) ₂ O ₄
Eosite	Pb(Mo.V) ₂ O ₄
Molybduran	UO ₂ .MoO ₃

The extraction of molybdenum compounds from molybdenite will be described here as typical of the methods used. The operations vary, of course, according to the product desired, and there are four main compounds of molybdenum in commerce—namely, the sulphide, the crude oxide, ammonium molybdate, and ferro-molybdenum. The preparation, however, starts in each case with the production of purified molybdenum sulphide.

Purification of Molybdenum Sulphide

The ore, after dressing in the usual way, is ground to a fine mesh and fused with acid sodium sulphate together with fluxing agents, which include lime, sufficient in quantity to convert all the silica to calcium silicate, and a small amount of gypsum and fluorspar. In some cases, as, for example, in the celebrated Mansfeld refineries, the molybdenum is smelted out with a considerable amount of iron and a molybdeniferous pig iron obtained. Fig. 1 shows the existence of a fir-tree

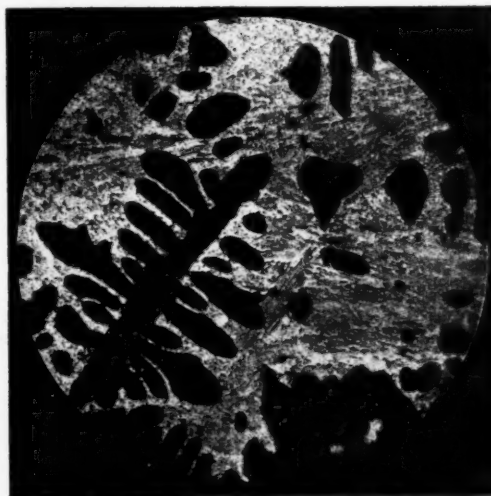
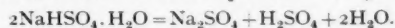


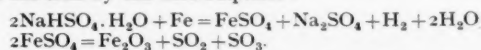
FIG. 1.—MOLYBDENIFEROUS PIG-IRON, SHOWING
FIR-TREE CRYSTAL.
[Picric Acid $\times 60$]

crystal of ferro-molybdenum in a matrix of cementitic appearance. The specimen from which the photomicrograph was obtained was etched with picric acid.

This molybdeniferous pig iron may be granulated and worked up into molybdenum sulphide by the smelting operation detailed above. The flow-sheet below indicates the path of the various products through the plant. The reaction in the case of the molybdeniferous iron depends mainly on the decomposition of the acid sodium sulphate at 800–850°C. thus:—

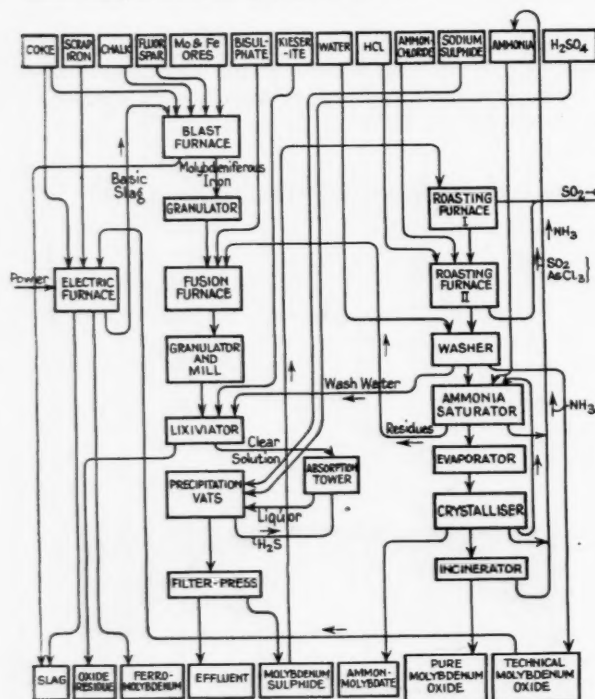


The acid produced, so to speak in the nascent state, is able to oxidise the iron granules with the formation of the oxide Fe₂O₃, whilst in addition the oxide Fe₂O₃ is produced to some extent by the reactions below, which involve a direct attack upon the iron by the acid sulphate:—



The fusion lasts several hours, after which the cooled material is ground to a very fine mesh and lixiviated with wash-water from the molybdic acid plant. The amount of water is adjusted until the solution contains about 4 gm./litre of molybdenum. Kieserite (native magnesium sulphate) is

now added to render the liquid less alkaline, and the whole is then allowed to settle, and the cleared liquid piped off to an absorption tower where it absorbs any hydrogen sulphide which escapes from the precipitation vats.



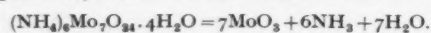
FLOW-SHEET OF PRODUCTION OF MOLYBDENUM AND DERIVATIVES.

Precipitation is effected by the addition of sodium sulphide solution and diluted sulphuric acid, when molybdenum sulphide is precipitated, and is washed and filtered off. The technical molybdenum sulphide so prepared analyses at about :—

Molybdenum	30-35 per cent.
Sulphur	40-52 per cent.
Water	12-15 per cent.
Phosphorus	0.04-0.07 per cent.
Arsenic	0.2 per cent.
Iron	3-4 per cent.
Sodium sulphate	1.5 per cent. (according to the thoroughness of washing).
Si, Cu, Ni, Co, V.	Traces.

Molybdic Acid and Ammonium Molybdate

The processes used for the conversion of the sulphide to molybdic acid and its salts are comparatively simple. The precipitated sulphide is given a preliminary roast to remove water vapour and convert some of the sulphide to oxide. It is then cooled, mixed with a little ammonium chloride and hydrochloric acid and roasted again. In this operation much of the arsenic present is eliminated as arsenic trichloride. After the roasting the cooled oxide is washed with water and dried, and as such constitutes the "technical" molybdic acid of commerce. Conversion to ammonium molybdate is effected by suspending the technical acid in water and saturating with ammonia gas. Ammonium molybdate passes into solution, which is filtered, evaporated, and the product recrystallised. The residue from the filtration contains a considerable amount of molybdenum, and is passed back to the fusion furnace. By incinerating the ammonium molybdate a fairly pure molybdenum oxide is obtained thus :—



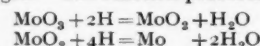
The ammonia is, of course, returned to the cycle. The table below gives the yields of molybdenum products from 100 tons

of molybdeniferous iron containing from 4-7 per cent. of molybdenum :—

PRODUCT (FROM 100 TONS OF MoFe)	PERCENTAGE OF Mo IN CRUDE.	
	4 per cent. Tons.	7 per cent. Tons.
Crude Molybdenum Sulphide (33% Mo)	12	21
"Technical" Molybdic Acid (60% Mo)	7	12
Pure Molybdic Acid (66% Mo)	6	10.5
Pure Ammonium Molybdate (54.3% Mo)	7.5	13
Ferro-molybdenum (60% Mo)	7	12
Ferro-molybdenum (75% Mo)	5.5	9

Preparation of the Metal

It is possible to obtain the metal by the reduction of the oxide with hydrogen. The reaction proceeds in two stages :—



but the second stage does not proceed at temperatures lower than 500° C.; indeed, it is best conducted at 900-1,000° C. Again, when molybdenum pentachloride and hydrogen are passed through a hot tube we obtain a crust of metallic molybdenum in a partially crystalline form. Such methods are not, however, of commercial importance, and the large scale methods may be divided into three groups: those employing (a) aluminothermic, (b) electrothermic, and (c) electrolytic principles.

Aluminothermic methods can be designed to produce either ferro-molybdenum or commercial molybdenum. In the case of the latter, dried and ground calcium molybdate and aluminium powder (No. 2) are fired in the usual way. Molten molybdenum remains at the bottom of the crucible, and prepared in this way usually contains traces of aluminium and calcium, together with a moderate percentage of molybdenum carbide, Mo_2C . Usually, however, ferro-molybdenum or ferro-silico-molybdenum are prepared by this process, and suitable quantities of iron oxide (usually Fe_3O_4) and silica are added, and the calcium molybdate replaced by molybdenum dioxide. The various "mixes" used are shown in Table I below, together with the proportion of iron and molybdenum in the ingot obtained.

TABLE I.
MIXTURES FOR ALUMINOTHERMIC PRODUCTION OF FERRO-MOLYBDENUM.

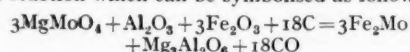
	Fe_2O_3	Fe_3O_4	MoO_3	Mo	Al	PRODUCT.	
						% Mo	% Fe
1	300	—	.30	—	78	46	53
2	—	175	115	—	87	46	53
3	—	450	—	45	110	47	53
4	—	175	130	—	87	53	46
5	—	88	77	—	45	53	36
6	—	160	160	—	66	78	22

Electrothermic methods are, as a rule, considerably cheaper to operate than aluminothermic processes and, moreover, they give a more satisfactory product. The first electrothermic preparation was that of Moissan, who used molybdic oxide (obtained by the ignition of ammonium molybdate) mixed with carbon and heated by means of an arc, running 800 amps. at 60 volts for five minutes. Such molybdenum was heavily contaminated with molybdenum carbide, but could be obtained 99.8 per cent. pure by the ingenious plan of remelting it in a crucible of molybdenum oxide.

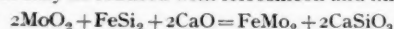
Whatever mixture is used in the commercial preparation of molybdenum and its alloys by electrothermic means, the furnace is very similar to that shown in Fig. 2. The furnace is in the form of a flat cylindrical shell of steel lined with sections moulded from a plastic mixture of alumina, calcium fluoride and tar, and baked until all organic matter has been removed and the alumina thoroughly bonded. The furnace is mounted on trunnions and has a mouth for pouring. This latter is closed with an iron plate, which is automatically opened when the furnace is tilted upon its axis by the rack and pinion below the false floor level. The furnace is completely enclosed, since both arsenic and carbon monoxide are produced during the reduction, and at the side a conduit (shown dotted) with a flexible elbow joint at the trunnion level serves to lead away the fumes to the dust chambers below the first floor, and finally to the stack. The cover, which is clamped to the body of the furnace, carries through it four electrodes, two positive and two negative, the latter being,

of course, thinner than the former, since they are consumed less rapidly. These electrodes are mounted on a cage with pulleys, and are free to move through the insulated bushes in the furnace cover.

The charge for such a furnace may be of several types. Magnesium molybdate may be reduced with ferro-bauxite and carbon, a reaction which can be symbolised as follows:—



or the oxide may be reduced with ferrosilicon and lime, thus:—



In the case of the latter process a charge consisting of $\frac{1}{2}$ ton of molybdenum oxide, 4 cwt. of 50 per cent. ferrosilicon, and 2 cwt. of lime is charged into the furnace, which is then completely closed. The electrodes are then touched down into the charge, which is sufficiently conducting to heat up, and later the arcs are established between the electrodes and the

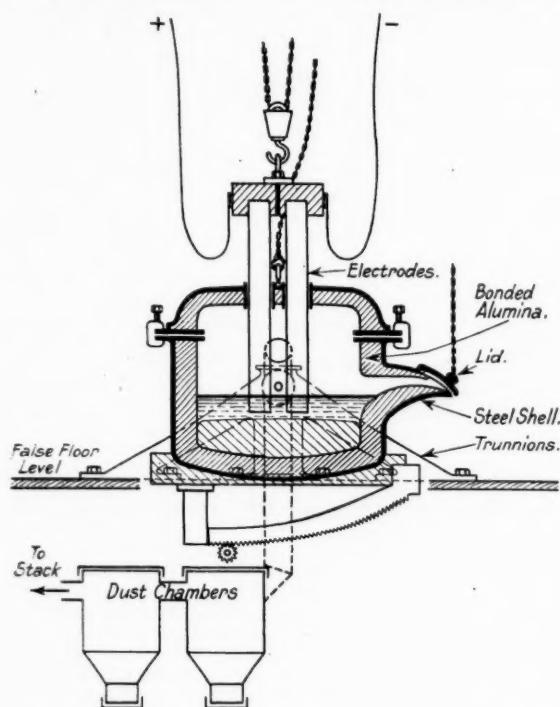


FIG. 2.—FURNACE FOR ELECTROTHERMIC PRODUCTION OF MOLYBDENUM.

charge. The furnace is run for about 60-75 minutes before the oxide is completely reduced to the metal, and for the above quantities 500 kw. hrs. are required to complete the reduction. At the completion of the reduction, molten iron (often containing 2 per cent. of tungsten) from an adjacent induction furnace is tipped in, the electrodes are withdrawn, and the charge tipped into ingots by rotating the furnace. In this way a ferromolybdenum is obtained corresponding to the following percentage analysis, which is from a typical sample:

Iron	76.34
Molybdenum	16.69
Tungsten	1.53
Carbon	4.20
Silicon	0.39
Manganese	0.37
Sulphur	0.08
Phosphorus	0.06
Arsenic	0.14 (According to the purity of the molybdenum oxide).

In all cases where the crude molybdenum oxide is used for the production of ferro-molybdenum, care has to be taken to remove the arsenic as far as possible, since a 30 per cent.

Mo ferro-molybdenum is expected to contain less than 0.08 per cent. of arsenic. As has already been shown above, the average analysis of the purified molybdenum oxide shows 0.25 per cent. of arsenic. Much of this can, however, be eliminated during the smelting and preliminary roasting as described below.

(To be concluded)

National Physical Laboratory Report

More Work on Beryllium

INCLUDED in the report of the year 1927 of the National Physical Laboratory, just issued (H.M. Stationery Office, pp. 264, 7s. 6d.), is the report on the department of metallurgy and metallurgical chemistry. Work on the preparation of pure metals has been continued. Extremely pure iron can be produced, containing only a trace of phosphorus, by the use of anodes of a high degree of purity and by modifying the conditions of electrodeposition. An apparatus capable of delivering a pound of pure chromium a day has been developed. Pure manganese and silicon are also under investigation. Especial attention may be drawn to the work on beryllium, directed towards the production of the metal in a purer and if possible more ductile form, and two principal methods have been used for this purpose. The most recent of these consists in depositing metallic beryllium from the vapour of the iodide when this compound is brought into contact with a tungsten filament at a suitable temperature. The chief difficulty of preparing beryllium by this method has been overcome and small but workable quantities of the metal have been obtained by this means. Unfortunately it has been found that the metal so deposited on the filament is slightly contaminated, and it is probable that a considerable amount of further work will be required before this contamination of the deposited beryllium can be prevented.

Among much other work done at the N.P.L. may also be mentioned that on light alloys, including those of aluminium, magnesium, and beryllium (in this case with aluminium). Work is also in hand on alloys for use at high temperatures, exploration being made of the high-temperature properties of alloys of nickel and chromium, and of nickel, chromium and iron to which in some cases tungsten and carbon are added.

Iron and Steel Statistics

THE National Federation of Iron and Steel Manufacturers has issued a volume entitled *Statistics of the Iron and Steel Industries* (1926), published from Caxton House, Tothill Street, Westminster, London, S.W.1. The volume, which contains 128 pages, and costs 5s. 4d. post free, contains statistics regarding the production of various types of ferrous products (pig iron, steel ingots and castings, semi-finished and finished steel, wrought iron) as well as with regard to prices, wages and labour, iron ore, coal and coke, imports and exports, etc. The countries dealt with include the United States, France, Germany, Belgium, Luxemburg, Sweden, Spain, Italy, Poland, Czecho-Slovakia, Argentine, Japan, Canada, India, Australia, New Zealand, and South Africa. In addition there is a section dealing with tariffs.

Refractories in Zinc Metallurgy

THE School of Mines and Metallurgy of the University of Missouri has issued a bulletin (pp. 139) on "Properties of Refractories in Zinc Metallurgy," by E. S. Wheeler (assistant research metallurgist), A. H. Kuechler (junior ceramic engineer), and H. M. Lawrence (metallurgist, U.S. Bureau of Mines). The frequent renewals of retorts and condensers, and the occasional repairing and rebuilding that a furnace requires in the metallurgy of zinc, warrant careful consideration of the raw materials, clay and grog, that are used for the manufacture of the refractory shapes. The investigation covers raw materials and body mixtures now in use, the comparative value of various grog materials, the comparative value of various clays, and the effect of reclaimed retort materials and zinc oxide upon the physical properties of retort mixtures. There are detailed discussions of the results obtained by the authors on each subject. There are 33 tables and 94 figures.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Metallurgy at the Royal Technical College

THE Royal Technical College, Glasgow, is an unusually enterprising institution. In addition to its own *Journal*, in which are published original papers on chemistry, physics, and engineering by members of the staff and students, there is also issued *The Royal Technical College Metallurgical Club Journal*, of which No. 6 (pp. 42, 28.) has just reached us. This publication contains papers not only from the staff and students, but also from distinguished investigators not connected with the Club. In the number now under notice, Dr. S. English writes on "The Solidification of Amorphous Matter"; Professor J. H. Andrew on "The Secondary Hardening of Alloy Steels"; Mr. J. M. Ferguson on "Some Constituents of Basic Open-hearth Slag"; Mr. J. G. Roberts on "The Electrodeposition of Chromium"; Dr. R. Hay on "The Function of Oxygen in the Dissolution of Metals and Minerals by Cyanide Solutions"; Mr. J. S. Glen Primrose on "High-speed Steel"; Mr. D. Binnie on "The Measurement of High Temperatures by Means of a Tungsten-Molybdenum Thermocouple"; Mr. S. L. Robertson on "The Volumetric Estimation of Copper and Zinc"; and Mr. G. Meikle on "The Soldering and Welding of Aluminium." The journal may be obtained from the secretary of the Club.

A New Iron-Making Process

METALLURGISTS nowadays are a hard-bitten lot and probably less disposed than any other class of men to "buy a pig in a poke." There have been processes and patents innumerable for the direct production of iron, some of them scientifically sound enough and yet commercially unworkable, and some of them neither. Iron and steel at 40s. per ton, or under, would, of course, revolutionise the world, besides driving many iron and steel-making concerns into a tight corner. What, however, is novel in the new Duffield process, respecting which no technical details appear to be forthcoming, is not the claim it makes, but the backing it has received, seeing that on the board of the company formed for its exploitation there appears the name of at least one metallurgist whose views, knowledge, and technical experience command no small measure of respect. Of the value of the process, and of its economic or scientific possibilities it is, of course, impossible to speak, seeing that the necessary particulars have not appeared on which to base an opinion. This notwithstanding, iron and steel men will await developments with interest, if only on account of the status and reputation of some of the promoters. Iron and steel are still the cheapest metals in the world—it is, indeed, because they are cheap that they occupy the position in industry that they do—and the prospect of greatly cheapening them holds out a number of possibilities, the exploitation of which would have extraordinary consequences.

Influence of Uranium on Iron

J. LAISSUS has concluded, in the February issue of the *Revue de Métallurgie*, his investigations on the case-hardening of ferrous alloys by various elements, with an account of experiments carried out with uranium as the medium. A 35 per cent. ferro-uranium containing 4.29 per cent. of carbon, and finely powdered, was employed in the research, and the temperatures of cementation ranged from 800° to 1,100° C. A eutectic of iron and uranium is formed, but it is not impossible that there may be a triple eutectic of uranium, iron and carbon as well. A marked hardening effect was noted and the surface of a mild steel specimen case-hardened in ferro-uranium was found capable of taking a beautiful polish which was not tarnished on exposure to air. Uranium-cemented steel is readily corroded by 50 per cent. hydrochloric acid, and by strong sulphuric acid, but withstands the action of nitric acid remarkably well. The whole range of the investigations comprised cementation by zirconium, titanium, vanadium, boron, chromium, molybdenum, cobalt, and tantalum, and interesting results as to the changes in the superficial hardness are recorded and summarised in a table. Depositing by electrolysis a coating of most of these metals and subsequently heating has much the same effect as packing them in compounds, powders, etc., and subjecting them to ordinary case-hardening operations.

Light Metals and Alloys

FROM the American universities and Government departments comes a steady stream of publications, on scientific and technical subjects, at a remarkably low price. Among the best of these are those issued by the Bureau of Standards, under the brilliant directorship of Dr. G. K. Burgess. Circular 346, the latest of these, the price of which is but \$1, is in itself a treatise on the subject to which it is devoted. It is entitled "Light Metals and Alloys," and deals with aluminium and magnesium; as it contains over 400 pages it constitutes a complete textbook on these metals, to which is added a section on silicon and beryllium, and their alloys. There is an exhaustive bibliography—with one very singular and, perhaps, deliberate omission, that of the only book on magnesium hitherto published in this country. Apart from this, the bibliography is, perhaps, the fullest and most conscientious of its kind ever compiled, and occupies 75 pages of very small print.

Magnesium Output Estimates

IT is difficult to obtain figures relative to the output of magnesium, and the American authorities have never allowed those for 1920 to be published; while so far as other years are concerned, the American figures are estimates only, and those for other countries are not available. Both the French and the German output figures are jealously guarded. Hence, exactly how much magnesium is being produced annually must be somewhat of a guess, except perhaps to those actually engaged in the industry, who have doubtless their own modes of eliciting information. American production may be inferred to be somewhere in the vicinity of 150 tons, and that of the rest of the world approximately the same, or possibly a little more, the total being presumably under rather than over 400 tons. There is some evidence that the output is being used; and as very little magnesium is employed in the older applications (such as ribbon, powder, etc.), and the amount alloyed with duralumin and other well-tried light alloys will hardly account for the whole of the output, it may be that the purer varieties of magnesium, such as Dow metal, Michel metal, etc., are being used in larger amounts for certain purposes than might be suspected. Those purposes are probably for aircraft parts, and similar "munition" applications. For commoner uses the corrosion problem has yet to be solved, and it is the difficulties in connection therewith that have hitherto made the development of magnesium mark time somewhat, as compared with that of aluminium. The plating of magnesium may prove to be a problem more easily solved than that of aluminium, and when the attendant difficulties have been surmounted greater developments may be looked for. As for beryllium, it has, up to now, been somewhat disappointing, and the expectations held respecting it have not been realised.

The Transformation of Matter

SIR ERNEST RUTHERFORD has chosen, as the subject of his Saturday lectures, a topic which is one upon which scientific imagination may still run riot, although within narrower limits than that of the alchemical theories of old. There has latterly been a reversion in some measure to the speculations of the ancients respecting the ultimate constitution of matter—or should we say energy?—but modern investigations are pursued by very different methods. The Coolidge tube and high tension electricity have superseded the alembic and invocations to *Bolfry*, who was a great and a terrible duke and "turneth all mettals into gold." Yet, although our apparatus and processes are dissimilar, the principles themselves do not differ greatly from those which underlay the attempts of the alchemists of old. "No mutation," said Webster, in his *Metallographia*, can be "but by motion," and he laid down three conditions under which, "hereafter," transmutation would be possible. They were: (1) by adding of something to the thing or subject to be changed, that it had not before; (2) by taking away and separating from the subject that is to be changed something that was in it before; and (3) by reason of motion so to alter, dispose, and order the texture of the parts that it should appear another thing than what it was before. When we remember that this was written

more than 250 years ago, and was but a restatement of views that had been held by the *illuminati* of the past for hundreds of years before that, it almost seems that, however much practice may have fallen short of theory in those days, the theory itself might well pass muster to-day, as an expression of incontrovertible facts!

Researches on Nickel

PROPAGANDA in respect of nickel is intensive and incessant. There seems to be always something new forthcoming in regard to the metal. In the circumstances, metallurgists will welcome the additions to the bibliography of the metal rendered available by the publication, *in extenso*, of the valuable papers presented at the Paris "Nickel Week," held in the autumn of last year. All these papers have now appeared in our contemporary, the *Revue de Métallurgie*. Probably the most interesting and important is the one by P. Chevenard, on "The High-percentage Nickel and Chromium Alloys." Hardly less so, however, is the paper by C. E. Guillaume, on "The Anomalies of Nickel Steels, and their Applications." The first-named paper assembles a very large number of three-dimensional diagrams relating to the dilatation, resistivity, internal friction, and viscosity, density and hardness of nickel-chromium alloys. The paper by Guillaume affords a large amount of valuable information respecting Invar and Elinvar, and shows how greatly the introduction of the former alloy has aided the work of geodesy, and contributed to the accuracy of its investigations.

Growing Use of Aluminium

PRESIDING on Friday, March 30, at the eighteenth ordinary general meeting of the British Aluminium Co., Ltd., in London, Lieut.-Colonel Stephen H. Pollen, C.M.G., said that the year's net profit was £432,176, against £438,776 in 1926. The demand, however, was well maintained. The tonnage delivered in 1927 was a record. A reassuring feature of the increased tonnage was that it covered a wider range of uses and forms of metal, both in the home and the export markets. Of the applications of the metal which showed large development, he would especially mention the use of aluminium for electrical conductors and for the electrical industry generally. The total weight of aluminium sold for such purposes in 1926 was double that for 1925, and similar sales in 1927 were 50 per cent. higher than in the previous year. The directors looked forward to an increasing demand for aluminium cable for power transmission throughout the world, and, in particular, in connection with those schemes which were to be fostered by the Central Electricity Board in this country. For the construction of the transmission lines of the Central Scottish scheme, steel-cored aluminium cable was specified, and the company secured the order for the metal.

The Transport Industries

THE motor industry continued to consume a substantial quantity of aluminium and its alloys in various forms and applications, and notably it was being used on a still larger scale for pistons. Increasing interest was being taken in the range of light alloys of aluminium, which had great strength and other satisfactory properties. These alloys possessed in a marked degree properties which were of the highest value in engineering construction, as compared with metals whose place they were likely to take, for example, in transport, where the reduction of deadweight was all-important, and also where heavy masses of material had to be frequently stopped and put in motion, and where reciprocating parts were concerned. For railway, road, air, and marine transport and other engineering applications, there should, therefore, be a growing demand for the strong light alloys of aluminium. The metal was being used to an increasing extent in the rubber, textile and brewing industries. Aluminium foil was displacing tin to some extent for the wrapping of tobacco, cigarettes, tea, and chocolates; and in powder form it was the basis of aluminium paint. In addition, the older applications, such as for cooking utensils, continued to develop, and the metal and its alloys were used in the construction of such general requirements as typewriters, gramophones, wireless sets, refrigerators, washing machines, and vacuum cleaners.

British Standard Grey Iron Castings

A SPECIFICATION which covers two grades of grey iron castings for general engineering work has just been published by the British Engineering Standards Association. Provision is made for both transverse and tensile tests, and the engineer or purchaser must state at the time of the inquiry whether he requires tensile or transverse tests or both. Three sizes of test bars, small, medium and large, have been standardised and are related to the main cross-sectional area of the casting or castings represented. Where the design of the castings permits, the engineer or purchaser may specify cast-on test bars. This specification (No. 321-1928) may be obtained from the British Engineering Standards Association (Publications Department), 28, Victoria Street, London, S.W.1, or from the publishers, Crosby, Lockwood and Son, 7, Stationers' Hall Court, London, E.C.4, price 2s. 2d., post free.

United Steel Companies' Scheme

IN the Chancery Division, on Monday, Mr. Justice Eve sanctioned the scheme of the United Steel Companies, Ltd., which will give the company a measure of relief to enable it to meet the present difficult conditions. Mr. Gordon Brown, for the company, said that there were three classes of debentures, all secured on different parts of the undertaking, but not by the general floating charge. There was also an issue of just over £1,000,000 of unsecured obligations, which had no charge at all. In 1926 the company guaranteed the payment of 8 per cent. dividend on £1,500,000 preference shares of £1 on the United Strip and Bar Mills, Ltd., a company formed to carry on one of the last processes in the manufacture of steel. The company had paid the interest on these various obligations up to the last day on which they fell due, with the exception of the preference dividends due in March. The scheme provided for a three years' moratorium, and during these years the interest was only to be paid out of profits, if available. The scheme had been carefully considered by the trustees, and carried by overwhelming majorities. No one appeared to oppose the application, which (as stated above) was sanctioned.

Accidents in the U.S. Metal Industry

A slight rise in the death rate and a small reduction in the injury rate were the main facts revealed by an examination of accident records covering the metallurgical industry (excluding steel mills) in the United States in 1926, according to the United States Bureau of Mines, Department of Commerce. The Bureau's examination of reports from operating companies revealed a fatality rate of 0.73 and an injury rate of 111 for each thousand persons employed, as compared with 0.66 and 116, respectively, for the year 1925. These accident rates are based on a standard of 300 working days per employee and include all accidents that disabled an employee beyond the day on which he was injured.

The Bureau's figures for the industry as a whole showed that 57,726 men were employed in 1926, slightly less than the number reported for the previous year. The employees worked 19,706,098 shifts, an average of 341 days per man. The average number of work-days per man represented an increase of four days over the average of 1925, but the aggregate number of shifts worked by all employees was slightly less than that for the preceding year. The accident reports are divided into three groups: those for ore-dressing plants; those for smelting plants (exclusive of the steel industry); and those for auxiliary works, including yards, shops, and construction work.

The chief causes of fatal accidents in 1926 were machinery, railway cars, suffocation in ore bins, haulage, falls of persons and falling objects. The main causes of non-fatal injuries were falling objects, falls of persons, machinery, hand-tools burns, and nails and splinters. Of the 7,327 deaths and injuries during the year, 48 resulted in the death of the injured employees, four caused permanent total disability, 223 caused permanent partial disability, 2,050 caused temporary disability lasting more than 14 days, and 5,002 caused temporary disability lasting more than the remainder of the day or shift on which the accident occurred but not more than 14 days. A detailed report covering metallurgical accidents in 1926 will be published within the near future.

Trade, Commerce, Finance: The Month in Review

From Our Market Correspondent

At the end of the first quarter of the year it is opportune to take a retrospect of the state of the iron and steel trade during the three months, and then endeavour to forecast what is likely to be its course in the immediate future. The story to be told is not cheerful, indeed it is rather disappointing. Although the year started with a certain amount of optimism, which was only natural at such a time, there was no substantial foundation for it, and this was shown by the fact that the industry soon settled down to the monotonous level which has been the experience of so many months past. In February there was a slight outburst of animation which revived hopes of an improvement in trade, but it quickly subsided without effecting any material change. Now the third month has passed, and conditions are no better than they were at the beginning of the quarter. The output of steel has been maintained at a comparatively high level during this period, but it has not been anything like sufficient to provide full time operation for all the mills, and at present business is rather dull and patchy.

Price Movements

Although in February an advance was made in the prices of the various classes of steel controlled by the Associations, this did not alter the net price to the steel makers, as the rebate was similarly increased; and only in a few instances where customers had not joined the rebate scheme was there any benefit to be derived from the advance. On the other hand, the prices of the uncontrolled materials have steadily fallen, and altogether the steel makers are in a less favourable position than they were at the commencement of the year.

When selling prices are within a narrow margin of manufacturing cost there is always some hope of turning a loss into a profit if full output can be maintained; but when conditions prevail such as we have experienced for some months past, with selling prices in many cases considerably below cost, and outputs far below the actual capacity of the works, there is little hope of profits; indeed, it is a hard struggle to make ends meet. Such has been the unpleasant experience of many of the steel makers through this first quarter of the year.

Reorganisation Necessary

Unfortunately it is not possible to predict any immediate improvement, as there are no grounds on which to base such an expectation. There is no prospect of any general development in trade which will be of such magnitude as to bring prosperity to the steel works. There will no doubt be slight changes up or down, but that is all that can be hoped for unless something exceptional takes place, either inside or outside the industry. There is little hope from the inside. A drastic reorganisation of the whole industry is necessary, obsolete and inefficient plants being scrapped, and the others remodelled and brought into line with the latest practice, but neither operation is likely to be carried out. There is not the money in the industry to finance the modernisation of the works, and borrowing powers have already been exercised to an extent which tends to place the effective control of the works in the hands of the financiers.

The best use has to be made of the existing plants, with such minor improvements as the straitened resources will allow, and in this respect we are at a decided disadvantage as compared with the continental works, who have been able to make use of inflated currencies and war settlements to rebuild entirely the whole of the steel works. Moreover, much of the business that is available can only be secured at losing prices, and in the choice between two evils many works prefer to compete for the orders at a loss rather than close down. Such a policy increases the difficulties of the trade generally. It is a common experience to find that certain special lines which have yielded a fair margin of profit are being subjected to such competition among the home makers that the profit has practically disappeared. Much of this trouble is ultimately due to the large excess of productive capacity about which we have so often spoken. Notwithstanding financial difficulties there is no effective reduction in this capacity, and the evil results are slowly but surely making themselves felt.

Trade Opinion on Safeguarding

The only outside help to which the makers can turn is something in the shape of safeguarding. Whatever may be its merits or demerits, one feels that it might give the industry breathing space and enable it to recover some, if not all, of the lost ground. The shortage of orders and the cutting of prices are largely due to the competition from the Continent, and it is to the home markets which draw their supplies from this source that the steel makers must look for that extra output which will keep them in full operation. Again, it is essential that selling prices should be brought into closer economic relation to production costs, and that cannot be done so long as there is no check on the absurdly low continental quotations.

The steel trade in the past has thrived in spite of competition at home and abroad, but we are now face to face with conditions which are unprecedented. The competition is of such a kind that it cannot be met by ordinary business methods, no matter how well they are directed. The cause is political, and therefore it is only reasonable to ask for Government help to overcome the difficulty. The industry is of sufficient importance to the country to demand consideration. Evidences are not lacking of the serious financial plight of many of the works, and although schemes of capital reorganisation are being and will have to be carried out, they do not really solve the problem.

Possibility of Increased Continental Prices

The stiffening of continental prices and the inability to give early delivery, which was a feature of last month, have not been of long duration. Deliveries can now be obtained much more promptly, and prices have receded. There is therefore at the moment no likelihood of increased business being diverted to the British makers. At the same time the opinion is widely held that continental prices are bound to increase, and every movement in that direction is welcome. In the meantime, there is not a great deal of buying from abroad, as consumers are disposed to wait in the hope that the fall in prices will continue. The weakness is particularly noticeable in semi-finished steel. The present prices of billets, plates, and small bars are about 20s. less than our home prices, while sections are nearer 40s. less.

The general market reports indicate the usual slackness in view of the approaching Easter holidays, although it is rather more pronounced than usual. Pig iron has been fairly steady during the month. The orders placed have not been sufficient to warrant an increase in production, but prices generally have been maintained; in fact, the Cleveland makers announced an advance of 1s. per ton a few weeks ago, but this was done probably to show that prices had really reached the bottom, and that no further reductions could be expected. The coke makers have decided to continue the present price of blast-furnace coke for another three months. The hematite market shows no improvement, and there is very little buying.

Steel Prices

In finished steel there is little or no change. In some quarters there is rather more business being placed, but generally speaking order books are far from full, and in no case is there any forward weight of orders. Plate orders are the most urgently needed; indeed there is little prospect of there ever being sufficient business to keep all the plate mills going. Small steel bars are competed for very keenly, and the manufacturers' prices are now on the same level as the re-rollers. There has recently been more cutting in this section of the trade than in any other, and present prices must be quite unremunerative in most cases. The actual condition is revealed by the fact that bars under 3 in. can be bought from British works at about £7 10s., while the association price for 3 in. and up is £8 17s. 6d. basis. The official prices for sections and plates remain unchanged at £7 17s. 6d. and £8 12s. 6d. respectively.

The output of pig iron in February amounted to 550,800 tons, compared with 560,500 tons in January. The output of steel was 764,400 tons, compared with 626,200 tons in January.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Alloys

In Patent Application 283,926 for a Patent of Addition to 252,028 (see THE CHEMICAL AGE, Vol. XV, p. 15 [Metallurgical Section]) bearing the International Convention date January 20, 1927, P. Berthelemy and V. H. De Montby, of Paris, propose (1) to restrict within predetermined narrow limits the proportion of bodies foreign to the aluminium, (2) to produce a rich alloy from cupro-manganese, cupro-ferro-silicon, cupro-tungsten and like materials containing copper, (3) to incorporate this alloy in a mass of French aluminium of 99-99.5 per cent. purity, and (4) to add finally an aluminium-magnesium-cadmium alloy.

In Patent Application 283,927, bearing the International Convention date January 20, 1927, T. Goldschmidt Akt.-Ges., of Essen, Germany, describe aluminium alloys containing 1.3 to 1.7 per cent. of magnesium silicide, 1 to 1.4 per cent. of copper, 0.3 to 0.7 per cent. of titanium, and, if desired, 0.5 to 1.1 per cent. of manganese. After being worked they are improved by heating at 520° to 550° C., cooling quickly, and ageing at 110° to 160° C. for six to 24 hours.

An alloy for use in electromagnetic apparatus and comprising 35 to 55 per cent. iron, 35 to 55 per cent. nickel, and 3 to 10 per cent. copper is the subject matter of Patent Application 283,931, bearing the International Convention date January 20, 1927, by H. F. Porter, of Trenton, New Jersey, U.S.A.

Iron

AKT. NORSK STAAL (Elektrisk-Gas-Reduktion), of Oslo, and E. Edwin, of Trondhjem, Norway, in Patent Specification 286,067, dated February 12, 1927, describe the production of synthetic pig iron by melting pure spongy iron (obtained by reducing iron ore and separating from gangue prior to melting) with pure carbonaceous material in an electric furnace under acid conditions at 1100° to 1300° C. Silicon or manganese may be added as required.

According to Soc. Anon. Fonderia Milanese di Acciaio, of Milan, Italy, iron or steel or cast-iron scrap is converted into steel by melting it in a cupola furnace and charging the melted metal together with iron oxide into an electric furnace for treatment in the usual way. A number of cupolas may be used with a number of electric furnaces, all operating without interruptions, while the current is continually being switched from furnace to furnace. See Patent Application 283,489, bearing the International Convention date January 10, 1927.

Vereinigte Stahlwerke Akt.-Ges., of Dusseldorf, Germany, propose to prevent edge or surface decarburising or carburising of iron or steel during annealing by conducting the operation in an atmosphere comprising a mixture, suitably proportioned according to the composition of the iron or steel, of carburising gases, such as carbon monoxide, methane, and coke-oven gas, and decarburising gases, such as blast furnace gas and nitrogen. See Patent Application 283,200, bearing the International Convention date January 8, 1927.

Chromium

THE GENERAL ELECTRIC CO. and C. J. Smithells, of London, describe in Patent Specification 285,571, dated November 18, 1926, the production of coherent bodies of chromium metal from pure powdered chromium. The powder is agglomerated into bars or other convenient shapes and sintered at 1500° to 1550° C. in an atmosphere of hydrogen free from all oxidising impurities. The pure chromium powder may be prepared electrolytically. The specially pure hydrogen may be obtained as described in Specification 284,808 (see THE CHEMICAL AGE, Vol. XVIII, p. 224).

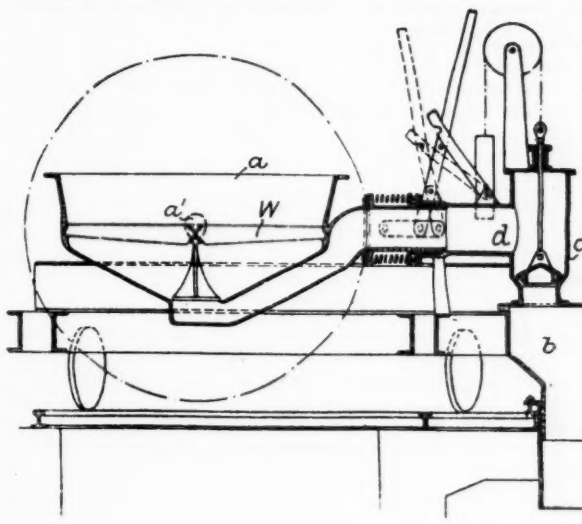
Chromium Plating

W. S. EATON, of Sag Harbor, New York, U.S.A., describes in Patent 284,900 (dated May 2, 1927), a method of depositing chromium uniformly from an electrolytic bath. The article to be plated is first subjected to a cleaning operation by using it as cathode in an alkaline bath. It is then rinsed in water and submerged, while coated with a film of water, as cathode in the plating bath which contains chromic acid solution and sodium hydroxide with a small proportion of sodium salts such as sulphate, carbonate, and chloride. This bath is preferably maintained at 110-130° F. during the plating operation.

Heat Treatment of Ores

ROASTING or agglomerating apparatus of the open pan type, designed to minimise the raising of dust in the discharging operation, is described by Soc. Anon. le Progrès et Metallurgique and A. De Samsonov of Brussels, in Patent Application 283,133, bearing the International Convention date January 4, 1927. In some constructions, with side discharge into a receiver or on to a conveyor, side walls of the pan are movable to permit the passage of a discharging ram across the grate. Alternatively, the grate may be of the endless-chain type and itself constitute the discharging member, or it may be a grid slidable horizontally for dumping the material into a suction chamber below it.

Ore mixed with fuel such as coal dust is sintered in pans *a* arranged in a circle about a central vacuum chamber *b*, with



a pipe connection for the air current from the bottom of each pan to the chamber through a valve *c*. Each pan is provided with a grate *W* and with journals *a*¹. A portion *d* of each pipe connection, in the plane of and at right angles to the journals *a*¹, is provided with a coupling which may be disconnected to enable the pan to be discharged by tilting. See Patent 284,793, by P. Anderson, of Västerås, Sweden, dated November 9, 1926.

In Patent Application 284,248, bearing the International Convention date January 26, 1927, Compagnie des Métaux Overpelt-Lommel, a Belgian firm, describe roasting or sintering of fine ores by blast apparatus. The ore is brought to suitable sulphur, etc. content, moistened, and compressed, a binder being added in some cases. It is then fed to an extrusion press for the production of threads, and these break into small grains which, after being dried and sifted, are roasted or sintered in a thin layer on the grate of the blast apparatus. The construction of a suitable extrusion press is also described.

Electrolytic Processes

CHEMISCHE FABRIK JOHANNISTHAL GES. and F. Frostler, of Berlin, in Patent Application 283,132, bearing the International Convention date January 4, 1927, describe a process for recovering copper and nickel from copper-nickel alloys, matte, or speiss by treatment as anode in a neutral or weakly basic electrolyte, *e.g.*, common salt solution. The electrolytic mud containing the precipitated hydroxides is treated, to bring the nickel hydroxide into solution, with a reagent such as a solution of a copper salt or iron sulphate lyes. Any lead present remains with the copper, together with arsenic and sulphur.

I.G. Farbenindustrie Akt.-Ges., of Frankfurt-on-Main, Germany, according to Patent Application 283,949, bearing the International Convention date January 21, 1927, obtain aluminium by electrolysis of fused calcined alumina which has been treated to increase its weight per unit volume by grinding under pressure as described in Specification 272,109.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—The tin bronzes. M. Hansen. *Zeitschrift anorganische Chem.*, Vol. 170, Parts 1-2, pp. 18-24 (in German).

The alloys of sodium-potassium-mercury-cadmium. E. Jänecke. *Zeitschrift Metallkunde*, March, pp. 113-117 (in German). The equilibrium diagram of the system Na-K-Hg has been accurately, and that of the system Na-Cd-Hg approximately, determined. Various other alloys in the system Na-K-Hg-Cd have been investigated. In addition to a number of binary compounds there are also the ternary compounds NaKHg₂ and NaCdHg.

Lead-tin-cadmium solders. C. E. Schwartz. *Brass World*, March, pp. 74-77. A study of certain alloys of the lead-tin-cadmium system with reference to their use as solders.

ANALYSIS.—Methods of analysis of duralumin and of light alloys in general. M. Tournaire. *Annales Chim. Analytique*, January 15, pp. 1-5; February 15, pp. 33-37 (in French).

The determination of manganese in iron and steel by the silver nitrate-persulphate method. S. W. Lipin. *Zeitschrift anal. Chem.*, Vol. 72, Parts 11-12, pp. 401-416 (in German).

The determination of the carbon content of pig iron and steel by combustion in a current of oxygen. J. Ciocchina. *Zeitschrift anal. Chem.*, Vol. 72, Parts 11-12, pp. 435-439 (in German).

A new gravimetric method for the determination of the titanium content of iron alloys. Separation of iron. J. Ciocchina. *Zeitschrift analytische Chem.*, Vol. 73, Parts 1-3, pp. 40-46 (in German).

The determination of antimony in bronze, brass, and other alloys. J. A. Tschernichof. *Zeitschrift analytische Chem.*, Vol. 73, Parts 7-8, pp. 265-270 (in German).

CHROMIUM PLATING.—Electrolytic chromium plating. J. H. Frydlander. *Revue Produits Chimiques*, January 15, pp. 1-9; January 31, pp. 41-49 (in French). A very thorough review of the subject.

The present position of chromium plating. E. Liebreich. *Korrosion und Metallschutz*, February, pp. 29-32 (in German).

CORROSION.—The practical problems of corrosion. V. Corrosion and protection at the contacts of dissimilar metals. U. R. Evans. *J.S.C.I.*, March 23, pp. 73-77.

Corrosion phenomena. XII. The apparent contradiction between the "catalytic" action of silver in the solution of zinc in acids and its position in the overpotential series. A. Thiel and J. Eckell. *Zeitschrift physikal. Chem.*, Vol. 132, Parts 1-2, pp. 78-82 (in German).

The A-B-C of corrosion-resisting steels. F. R. Palmer. *Chem. Met. Engineering*, March, p. 149.

The corrosion of aluminium. Report on the work of the German aluminium investigation committee. W. Guertler. *Zeitschrift Metallkunde*, March, pp. 104-112 (in German). Deals with the theory of aluminium corrosion; nature of protective skins; composition, physical condition, and surface condition of investigated materials; safe and unsafe chemicals for aluminium; significance of the bounding surface between air and moisture; points of view in production, in the casting, rolling, annealing, welding, etc., of aluminium with regard to the prevention of corrosion, the treatment of aluminium in use; plan for further investigations.

GENERAL.—Changes in structure and electrical resistance on the cold-working of metals. G. Tammann and M. Straumanis. *Zeitschrift anorganische Chem.*, Vol. 169, Part 4, February 11, pp. 365-380 (in German).

High speed, high voltage X-ray diffraction analysis of metals. A. St. John. *Transactions Amer. Soc. Steel Treating*, March, pp. 485-492. A quick and convenient method of X-ray diffraction analysis has been developed. It is a modification of the usual "pinhole" method using tungsten radiation at 200,000 volts as in radiographing castings, so that a powerful beam passes through

$\frac{1}{8}$ inch of steel. The method has been applied to brass, tin, and steel, in the study of mechanical working, heat treatment, extrusion, ageing, and the effect of exposure to gases.

Fusing porcelain enamel on to iron and steel. F. W. Manker. *Brass World*, March, pp. 71-73.

The solubility of silver in mercury. A. A. Sunier and C. B. Hess. *J. Amer. Chem. Soc.*, March, pp. 662-668.

Heat-resistant alloys. W. Rohn. *Korrosion und Metallschutz*, February, pp. 25-28 (in German).

MECHANICAL PROPERTIES.—The deformation of crystals of β -brass. G. I. Taylor. *Proc. Roy. Soc. A.*, March 1, pp. 1-24. It is shown that β -brass, which has a structure similar to that of α -iron, behaves in a similar, though not identical, manner on distortion.

SINGLE METALS.—Electrolytic removal of tin from copper wastes. W. W. Stender and A. A. Iwanoff. *Zeitschrift anorganische Chem.*, Vol. 169, Part 4, February 11, pp. 399-404 (in German).

The question of an allotropic transformation point of aluminium. W. Guertler and L. Anastasiadis. *Zeitschrift physikal. Chem.*, Vol. 132, Parts 1-2, pp. 149-156 (in German).

The working-up of gold and silver wastes. W. Adolphi. *Chemiker-Zeitung*, February 8, pp. 109-111 (in German).

The electrolytic separation of chromium from aqueous solutions of chromic acid. V. Schischkin and H. Gernet. *Zeitschrift für Elektrochemie*, February, pp. 57-62 (in German).

Initial materials for the extraction of aluminium. C. Faessler. *Canadian Chem. Met.*, February, pp. 35-39 (in French).

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case, the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

HEATH (ROBERT) AND LOW MOOR, LTD., Stoke-on-Trent, coal and ironmasters.—Registered February 23, £33,000 part of amount already registered; general charge. *£1,170,380. July 27, 1927.

MONDEGO TIN DREDGING CO., LTD., London, E.C.—Registered February 28, £1,000, part of amount already registered; general charge. *£56,500. December 31, 1927.

SHEEPBRIDGE COAL AND IRON CO., LTD.—Registered March 7, £500 and £450 debentures, part of £750,000; general charge excluding uncalled capital and certain property. *£580,050. October 10, 1927.

SHIPMAN (J.) AND CO., LTD., Sheffield, steel manufacturers.—Registered February 25, debenture to G. E. Granson, 9, Bank Street, Sheffield, solicitor, and Mosley Street, Nominees, Ltd., 38, Mosley Street, Manchester, securing all moneys due or to become due to Williams Deacon's Bank, Ltd., and Wardsend Steel Co.; general charge (subject, etc.). *£42,577. January 3, 1928.

Satisfactions

BLAENAVON CO., LTD., coal and ironmasters.—Satisfaction registered March 17, £2,400, part of amount registered August 24, 1911.

FRODINGHAM IRON AND STEEL CO., LTD.—Satisfactions registered February 21, £40,000, part of amount registered October 12, 1917, and £7,495, part of amount registered June 20, 1925.

HOLWELL IRON CO., LTD., Ashfordby.—Satisfaction registered March 14, £150,000, registered October 6, 1902, and February 5, 1909.

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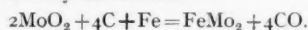
NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

The Extraction and Utilisation of Molybdenum.—(II)

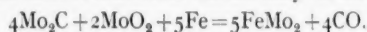
By G. Malcolm Dyson, Ph.D., A.I.C.

The following is the conclusion of Dr. Dyson's article on molybdenum, the first part of which appeared last month (April 7). In this concluding part, the author deals with the electrolytic production of the metal and the production of ferro-molybdenum, among other things.

THE methods for producing ferro-molybdenum free from silicon almost invariably involve the presence of iron in the charge, either as the metal or the oxide. The principal reaction involved may be written:—



Such a reduction yields a carboniferous ferro-molybdenum, but by replacing the carbon by molybdenum carbide, a molybdenum almost free from carbon may be obtained:—

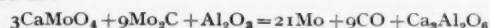


This reaction appears to be pre-eminently suited to the recently introduced induction furnace, provided that a suitable type could be devised. As far as the author is aware, no such furnace has been used. In place of iron, Swedish iron ore can be used, and the reduction of molybdenum and iron effected in one operation, the charge being prepared in the following way:—Molybdic acid (2 cwt.) is mixed with a high quality powdered Swedish iron ore (80 lbs.), and wood charcoal or ground carbon electrodes (60 lbs.), chalk (18 lbs.), and fluorspar (8 lbs.). These are mixed into a thick paste with crude magnesium chloride liquor (the end-product of the potash refineries), and the mass briquetted and roasted at 700° C. in a large iron vessel from which the air is excluded. The chlorine obtained from the decomposition of the magnesium chloride serves to remove much of the arsenic as volatile arsenic chloride. The cooled and crushed briquettes are charged to the furnace and treated as before, 900-1,000 kw. hours being required. The slag in this reduction is strongly basic, and serves to remove much of the phosphorus that may be present. Even so, the crude ferro-molybdenum has to be refined before use with high grade steel. It is refined by melting for five hours with a little iron ore, chalk, and fluorspar in large crucibles, the current consumption being 2 kw. hours per kg. of refined metal. The extent of purification is shown by the analyses below:—

	I. Crude Ferro- molybdenum Per cent.	II. Refined Ferro- molybdenum Per cent.
Molybdenum.....	58.0	56.0
Iron	40.0	43.3
Carbon	1.8	0.5
Arsenic	0.08	0.4
Phosphorus	0.05	0.03
Sulphur	0.1	0.1

Electrolytic Production of Molybdenum

Two principal methods of electrolytic extraction of molybdenum have been practised, namely, the electrolysis of calcium molybdate in fused bauxite, and the electrolysis of the fused double chloride of molybdenum and sodium. In the former method it is difficult to say precisely what goes on in the furnace, and the process really appears to be, in part at any rate, an electrothermic one. The reaction has been represented as:—



The electrodes are a high percentage Mo ferro-molybdenum on the cathode side, with carbon anodes.

The electrolysis of sodium molybdenum chloride is a more

satisfactory process, although even in this case the formation of metal "fogs" in the electrolyte may lead to trouble in the conduct of the operation. The "furnace" consists of two parts, the upper comprising a set of carbon electrodes (with necessary mechanical arrangements for raising and lowering them under a hood through which the chlorine evolved may be sucked off); and the lower part a series of trucks which can be moved along rails under the anode section (Fig. 3). The trucks consist of a steel shell lined with small refractory

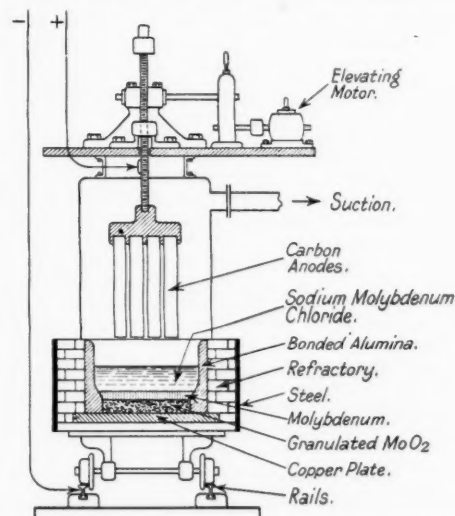


FIG. 3.—ELECTROLYSIS OF SODIUM MOLYBDENUM CHLORIDE.

bricks at the sides, but finishing at the bottom in a massive copper plate. The walls are further protected with a lining of bonded aluminium oxide, but the copper cathode is protected with a closely packed layer of granular molybdenum oxide which forms the "acting" cathode. The charge consists of a double chloride of molybdenum and sodium obtained by heating together molybdenum carbide, silica, and salt, and conducting the vapours through sodium chloride. The current density used is 1-1.5 amp. per sq. cm. of anode surface at 9-10 volts.

Properties and Uses of Molybdenum

Pure molybdenum is seldom met with, but is a very bright white malleable metal, m.p. 1800-2,000° C. It can be forged hot, and although soft takes a ready polish. It combines very rapidly with boron, silicon, carbon, and phosphorus, and even at low red heat is converted into an oxide which is volatile. It is, therefore, eminently suited for the function of a "scavenger" in steel production (quite apart from the question of alloys), and has rendered possible the production of a high quality steel in the Bessemer process at a very low cost.

Molybdenum may be added to steel in several ways—as one of the silicides Mo_2Si_3 and Mo_2Si , where silicon is to be added as well as molybdenum, or in the form of various alloys with other metals. Thus two "patent" alloys for addition to steel for the production of a clean, malleable, but tough product, were found to have the following analysis: (No. I is recommended for large forgings, 1.5 per cent. being added, whilst No. II is added in quantities up to 3 per cent. for the production of steel for shell cases):

	Per cent.	
	I.	II.
Molybdenum.....	70.53	36.25
Nickel	21.6	57.8
Tungsten	1.27	—
Iron	3.08	1.6
Carbon	2.94	1.08
Silicon	0.42	0.14
Sulphur	traces	traces
Manganese	0.40	traces

There is little doubt that the bulk of molybdenum is utilised in the manufacture of high speed tool steel containing from 5-10 per cent. of molybdenum. Such steel is intensely tough, far less liable to crack, and capable of standing extremely heavy torques. Its use is indicated in the case of propeller shafts. In addition it retains its temper at a dull

red heat. The increase of strength in forged molybdenum steel increases with the molybdenum content up to a certain point, a fact which is shown graphically in Fig. 4. Other uses

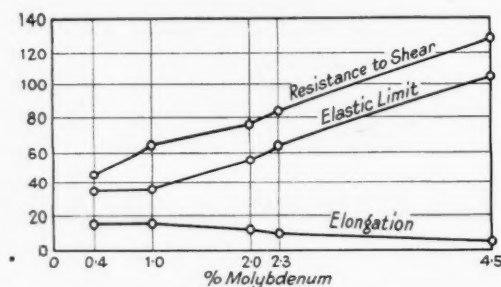


FIG. 4.—STRENGTH OF FORGED MOLYBDENUM STEEL.

of molybdenum compounds include the use of ammonium molybdate (and molybdic oxide) in the production of blue colours in ceramic glazes, and the use of the precipitated sulphide in the production of rubber.

Cohesion at Soldered Joints

By T. B. Crow

The following extracts from a paper read before the Faraday Society at their symposium on "Cohesion" are of great interest, being a scientific study of what has hitherto been a rule-of-thumb operation.

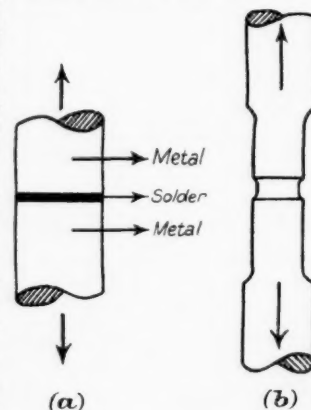
A PIECE of metal with a soldered joint in its middle may be considered (in regard to its cohesion as measured by mechanical tests) from two aspects, namely (1) as one compound piece of metal capable of resisting, as a whole, a certain stress, and (2) as a composite material (consisting of at least two macroscopically distinct members), whose breaking strength must be compared with the respective tenacities of the two constituent members. What will be the strength of a joint, considered as a simple test piece, in terms of the strength of the solder in it? The ability of a soldered joint, such as Fig. 1(a), to withstand of itself rupture by a tensile force is evidently dependent upon the capacity of the solder to form a waist; i.e., to flow: a possibility closely connected with the surface tensions operating at the interfaces with the copper. The same thing, of course, is true if a test bar be grooved as shown in Fig. 1(b); such a bar will "pull higher" than one of the same material not similarly grooved. Will fracture take place in the body-metal, in the solder, or at an interface? Is there an interface?

Some Properties of Soldered Joints

I found that, with electrolytic copper rods and solder of eutectic composition:—

- (1) Decrease of gap width increased the tensile strength up to a maximum of about 14 tons/sq. in.; after which further decrease in gap width (obtained by the agency of pressure) corresponded with a falling off in strength. In all these cases the solder used, when tested as solder, had a tensile strength of about 4 tons per sq. inch.
- (2) The highest ultimate load of a joint was always below the yield point of the copper.
- (3) Elongation and yield points were observed only in those joints where there was a considerable thickness of solder in the gap; when the gap was 5.1 mm. (on a test piece having diameter of $\frac{1}{8}$ in.) the test bar broke at a load about equal to that of ordinary eutectic solder.
- (4) There was a certain temperature of soldering which gave a maximum strength, above which it rapidly fell off to about $\frac{1}{2}$ of the maximum value.
- (5) The microstructure of joints showed (a) the presence of an interfacial layer of copper-tin alloy (which is believed to correspond to Heycock and Neville's "H" constituent) between the copper and the solder, and (b) in joints made at higher temperature the development of a second phase, η , which appeared between the "H" and the mass of unchanged copper.
- (6) In both classes of joint (i.e., those containing H only, or

η and H) fracture occurred in the region of the contact alloys on both sides of the central band of unchanged solder, through which the fracture also passed in steep cliff-like faces. The "high" and "low" levels thus formed each revealed two levels, which were of different shades. Thus in the case of "H" joints, fracture occurred through the solder and through the contact-alloy H, in these contact-alloy regions. In the η +H joints, fracture occurred in the solder, the H, and the η in the contact-alloy regions as well as through the solder mass itself, as before. In both classes of joint there is a possibility of the plane of fracture passing through an H-solder or an H- η interface, though the adhesion between these (respective) materials may be, and probably is, very great.



Different Aspects of Joining of Substances

Two instances may be singled out for mention, in relation to joining of substances, illustrative of the widely different natures of the processes involved. Photo-micrographs of sections through glued joints of wood indicated that there is a running up of liquid glue between the fibres of the wood by capillary attraction. Might not, then, an analogous series of solder hooks be formed between grains of body-metal? If this were so, grain size would have an important bearing upon the strength of joints.

The other instance relates to the "cohesive-adhesion" of electro-deposited nickel upon steel, etc., when carried out under the special conditions devised by Mr. Fletcher, inventor of the "Fescol" process for building up, by deposition of nickel, worn parts of machinery. Specially "built up" test bars were made and tested; in every case the bond of adhesion across the steel-nickel interface was stronger than the cohesion of the nickel itself, in which the fractures occurred. These observations caused Messrs. Heape and Grieg (*Trans. Faraday Soc.*) to incline to the belief that alloying was not an essential of a good soldered joint.

Refining Scrap Lead

(FROM A CORRESPONDENT.)

SCRAP lead usually accumulates in the form of old sheets, pipes, and occasionally small lead castings. When it is desired to dispose of this material, the customary practice is to melt it in a small kettle and run the molten metal into ingot moulds. Comparatively few attempts are made at refining the metal, and as the price fetched for the ingots largely rests on the purity, the simple refining methods adopted are worth consideration. The following brief description embraces the modern methods adopted by recognised authorities for refining lead from scrap.

Refining processes resolve themselves into the separation of copper by sweating or by means of zinc, and the extraction of other metals, with the exception of bismuth and the precious metals, by melting in an oxidising atmosphere. If the amount of copper is considerable, the lead is first sweated in a special liquation furnace; otherwise the copper, together with some other constituents, is eliminated when the lead is melted in pots or in the refining furnace, in the form of a scum, which rises to the surface of the molten metal and can be skimmed off. Further purification of the lead is effected by prolonged oxidation. In the Parkes process of lead refining by means of zinc, a very perfect separation of copper is effected, as the last portions alloy with the zinc and are taken off with the zinc scum. The oxidising fusion is effected by the agency of air, or when certain elements are present, steam or lead oxide may also be used as oxidising agents.

Iron, Zinc, Arsenic, and Antimony

Iron, which is only present to a small extent in lead, is easily oxidised as soon as the temperature of the molten bath of metal reaches dull redness; sulphur behaves similarly, and also nickel and cobalt if not present in excess. Zinc easily oxidises when the molten lead attains a red heat in contact with air, and it is also readily attacked and removed as oxide by blowing steam through the molten metal, hydrogen being liberated at the same time. It can also be removed by melting with litharge in reverberatory furnaces, or, as was formerly practised, by melting the zinciferous lead with tap cinder in blast furnaces, the zinc going into the slag. Zinc can also be removed as chloride by melting the lead with chlorides such as common salt. As a rule, air is employed as an oxidising agent for the removal of the zinc, or to a lesser degree, steam, the use of chlorides being rare. Tin is readily oxidised at a red heat, and separates thereby as a dross on the surface of the bath. Arsenic and antimony when present in lead are oxidised at a red heat in presence of air, forming arsenate and antimonate of lead, which separate out as dross on the surface of the molten metal. The oxidation of both metals is promoted by a blast of air and by making lead oxide serve as an oxidising agent, the use of an air-blast being particularly necessary when large quantities of arsenic and antimony are present.

The separation of the foreign metals is promoted by constantly renewing the surface of the lead exposed to the oxidising agent. To attain the same end, steam is blown through the lead, or it is poled with green wood, the violent agitation produced in both cases exposing large fresh surfaces of lead to the air. Saltpetre and sodium carbonate and hydrate were formerly also used as oxidising agents.

Apparatus Required

The selection of the particular form of apparatus to be used for the purification of lead depends on the degree of purity required, the forms of apparatus being fore-hearths, pots of cast-iron or cast-steel, and reverberatory furnaces. Purification in the fore-hearth is only resorted to when the amount of impurity present in the lead is small, consisting chiefly of small quantities of copper or zinc. Antimony when present in small quantities can also be removed by poling the metal at a red heat.

Purification is carried on in pots when the lead does not contain too much copper, and a proportionately small quantity of antimony and particularly of arsenic; zinc, however, may be present up to the point of saturation. Refining in reverberatory furnaces is applicable to all varieties of lead containing larger amounts of copper, arsenic, and antimony, and reverberatory furnaces are also used for extracting the zinc from lead. If very large percentages of copper are present,

a preliminary liquation is resorted to before refining, but otherwise the elimination of the copper is effected in the reverberatory, refining, or softening furnace, before the other impurities are removed.

Refining in Fore-hearths, Pots, etc.

When molten metal at a red heat is permitted to cool down in order that it may attain the necessary temperature for casting into moulds, the copper and zinc contained in it separate out on the surface as a skin or crust, this skin being removed by means of a wooden or iron scraper as fast as it is formed. Large quantities of copper cannot be removed in this manner, as the lead soon cools down to the casting temperature. Small quantities of antimony and arsenic can be removed from lead by poling it with green wood or a bundle of green twigs, while heated to redness in the tapping hearth.

Refining in pots serves equally well for the separation of copper or nickel as for other elements, the copper or nickel separating out on the surface of the bath of metal when it is first melted. The last portions of copper can be removed by the addition of zinc, which alloys with the copper, the alloy being skimmed off on rising to the surface. For the removal of the other elements (tin, arsenic, antimony, and zinc), the bath of metal must be heated to redness and exposed to the action of the air as much as possible, poling or the blowing through of steam being employed for this purpose. When steam is blown through, the pot is covered with a hood having an exit pipe for the vapours and an opening for the entrance of air. If the molten bath contains zinc, the water is decomposed, hydrogen being evolved, so that the presence of air is not requisite in this case; antimony and arsenic, however, exert no such action, and the presence of air is therefore necessary in case they exist in the lead.

Casehardening by Sodium Cyanide

A 30-PAGE pamphlet entitled *A Treatise on Casehardening and the Heat-Treatment of Steel by Sodium Cyanide*, illustrated by microphotographs, etc., has been issued by the Cassell Cyanide Co., Ltd., of Glasgow (now under the control of Imperial Chemical Industries, Ltd.). Some of the headings are as follows: carburising properties of sodium cyanide; the practice of the process (this contains many valuable notes on suitable pots, and methods of using them with the greatest possible efficiency); temperature control; general working; penetration; strength of bath; and hardness (illustrated with graphs and microphotographs showing the influence on the hardness of the cyanide content of the bath); prevention of cyanide losses; treatment of special steels; local carburisation; reheating baths. Accounts are also given, illustrated by diagrams, of two furnaces, gas- and coke-fired respectively, for cyanide casehardening. Among the products of the company are sodium cyanide (97-98 per cent. pure); sodium potassium cyanide mixture; copper cyanide (96-98 per cent. pure); sodium copper cyanide mixture; zinc cyanide (97-99 per cent. pure); sodium zinc cyanide mixture, etc.

Resistant Steels

A VOLUME entitled *Steels Specially Resistant to Corrosion and Heat*, being a text-book of data collected from investigations in their research laboratories and works, has been published by Thos. Firth and Sons, Ltd., of Sheffield (pp. 74, 10s. 6d.). The book deals first with Firth stainless steel (which contains chromium), and Firth Staybrite steel (which contains chromium and nickel), and discusses various operations on these steels, such as machining, surface polishing, welding, soft and hard soldering, etc. An account of the general physical properties of the steels, and of their application (in which a long discussion is given of applications in chemical engineering), leads up to a group of very valuable tables, in which the behaviour of the steels towards various chemical and other influences, under varying conditions, is summarised. The last section of the book deals with Firth "H. R. Crown" heat-resisting steel, a steel containing substantial quantities of chromium, nickel, and tungsten. It is claimed that this steel has great mechanical strength at high temperatures, and great resistance to scaling, and that it can be submitted to temperatures even in excess of 900° C. for considerable periods without seriously scaling.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

The Iron and Steel Institute

THE Iron and Steel Institute, which has been holding its annual meeting this week, has had, as usual, an over-loaded programme of papers to get through. On the other hand, that programme has been one of exceptional interest, and the papers have been of a higher standard than usual. Mr. Talbot, who has been elected president for the coming twelve-month, is also president of the National Federation of Iron and Steel Manufacturers, the present occasion being the first on which the dual rôle has been played by the same person. Apart from the scientific interest attaching to this year's meeting of the Institute, the commercial aspect of the occasion is of unusual importance, seeing that Mr. Chas. Schwab, who has been awarded the Bessemer Medal, is over on a mission which will probably have considerable influence on the future destinies of the British iron and steel trades. There may thus be said to be a quickening, not on the technical side alone, but along the collateral side of business efficiency, administration, and organisation generally. Mr. Talbot, in his address, maintains the traditional reserve so seldom departed from in presidential addresses before the Institute in regard to these aspects of industrial activity, and confines himself to a review of the progress of open-hearth steel processes, in the development of which he has himself played so distinguished a part.

Heterogeneity of Steel Ingots

THE second report on the Heterogeneity of Steel Ingots, presented by the Institute committee appointed to deal with this subject, is a much more complete document than the first report presented two years ago. The committee appears to have got into its stride, and its chairman, Dr. W. H. Hatfield, may be warmly congratulated on the result. It is a voluminous report consisting of nearly 150 pages of text and 18 plates, and as there is neither a synopsis nor any conclusions stated, those desirous of knowing what the committee have to say must perforce read it through, a task which will well repay them. Indeed, no general conclusions are possible, the number of ingots investigated from the point of view of heterogeneity being too small, and their sizes, composition, and conditions of casting far too varied to render any general conclusions legitimate. This notwithstanding, some general principles do emerge, and one is the extraordinary extent to which the bath or test samples coincide, in chemical composition, with the average analysis of single ingots in the cast, despite the extreme variations in their composition in different localities, due to segregation. Evidently, as far as composition is concerned, open-hearth baths are perfectly homogeneous. Whether, as metallurgical practice extends, greater control of the conditions during cooling will be found to reduce the heterogeneity of the solid ingot, remains to be seen. The report appears to foreshadow that, in the future, moulds may be so designed as to reduce harmful segregation "to a minimum," but admits, as an offset, that a number of other variables are at work. It is possible that data of more real value would have emerged had the committee confined its attention to a larger number of smaller ingots of more regularly comparable composition, in which the predominating variables might have been confined to temperature of tapping and teeming, rate of teeming, and mould shape and thickness.

Ingots Selected

EIGHTEEN ingots were selected—it must be remembered that the ingots in question were placed at the disposal of the committee by the courtesy of the firms which contributed to render the investigations possible, and that it was not therefore possible for the committee to pick and choose—varying from 15 cwt. in weight to 119½ tons. It is difficult to see how anything "comparable" could have been expected to emerge in the case of cooling masses so diverse. Their composition ranged almost as widely, no less than nine of them being alloy steels. The weights of the moulds varied from 15 cwt. to 64 tons. The shapes also varied. In the case of the largest ingot, which contained nickel, chromium and molybdenum, the chromium varied to the extent of 30 per cent., and the molybdenum by 70 per cent., according to the position from which sample drillings for analysis were taken. As was inevitable,

casting temperatures likewise varied considerably. In spite of all this, the report of the committee is highly suggestive, and some further interesting research work is in hand. Investigations on density changes in steel in the neighbourhood of the melting point, and on the viscosity of molten steel, are being undertaken, under the direction of Professor Desch, at Sheffield University, and investigations on the freezing and melting ranges of various types of steel at the Royal Technical College, Glasgow, by Professor Andrew.

Blast Furnace Papers

THERE are several papers dealing with blast-furnace practice, or with the behaviour of coke. Mr. Vernon Harbord contributes his maiden paper on "A Comparison of the Most Important Methods Employed in the Cleaning of Blast-Furnace Gas," and comes to the conclusion that electrostatic plants cost less to operate but that the most efficient wet washers are of the combined tower and disintegrator type. Coke reactivity is discussed by J. H. Jones, J. G. King, and F. S. Sinnatt, while E. C. Evans and F. J. Bailey have amassed a valuable amount of information in their paper on "Blast-Furnace Data and Their Correlation," and give very complete particulars of the working of no less than 123 blast-furnaces running on widely different burdens. Blast-furnace practice in Natal is dealt with by J. E. Holgate and R. R. F. Walton, who describe the plant of the Union Steel Corporation of South Africa, and A. Crooke and J. Thomson give an account of the new plant of the Appleby Iron Co., Ltd., which now includes six blast furnaces and a well-equipped steel department and rolling mills.

American Electro-Chemical Society

THE American Electro-chemical Society's annual general meeting, which was held from April 26 to 28, at Bridgeport, Connecticut, is always an important fixture, and invariably has many very interesting papers before it. Among these is an account of some pioneer work on the "Electrodeposition of Thallium," by O. W. Brown and A. McGlynn. A solution of pure thallium sulphate was prepared by a method described in the paper, and platinum electrodes were used. Fluosilicate, perchlorate, and other baths were also tried. The latter proved a good conductor, and with low current densities (0.5 amps/sq. dm.), good, smooth and coherent deposits were obtained. The perennial problem of electro-plating on aluminium has been tackled by H. K. Work, who regards all attempts at electro-plating smooth aluminium surfaces as of doubtful value unless heat-treated. On the other hand, plating on a roughened surface gives good results. In most cases nickel is the best metal to plate on aluminium. Electrodeposition and its method forms but a part of the American Electro-Chemical Society's activities, however, and many papers of general metallurgical interest were on the programme, particularly those dealing with electrical heating, melting and annealing of non-ferrous metals.

Ultra-Thin Metal Sheets

SHEETS of metal so thin that ordinary type can be read through them, are now available as the result of research by Dr. Carl Mueller, of the Charlottenburg Laboratory, Berlin. In a note in *Nature* it is stated that his method of preparing them is to electroplate the metal on the surface of some soluble substance, such as rocksalt, and then dissolve away the support. A ring of thicker metal can be used to support the films, of which two and a half million would have to be piled to make a stack an inch high. Such films have been made of iron, nickel, gold, silver, and platinum, and it is found that although the nickel is much less transparent to visible light than gold, it readily transmits the shorter ultra-violet rays. The films are very elastic, and will bulge out for as much as a tenth of their diameter without breaking. Another curious thing about them is their high electrical conductivity. As they are practically all surface, a strip of film containing no more metal than in a round wire, one-hundredth of a millimetre in diameter, will carry enough current to light several lamps; if the same current were passed through the wire, the latter would be instantly melted. This film may find use in radio and photographic reproducers, since ordinary diaphragms are so heavy that they dampen some of the overtones and so coarsen the sounds.

Swedish Copper Ore Find

THE Swedish State Chemical Laboratory has made a report on samples of ore found in Vannas, near Umeaa, in the north of the Gulf of Bothnia. The examination shows that the ore contains no less than 31.4 per cent. of copper, against the 16 per cent. of the well-known Boliden ore. According to the Swedish Press, the ore field from which the samples were taken is about 24 miles in length, but the breadth is comparatively small. For a distance of two miles the ore reaches the surface, but investigations have shown that it increases in value with depth. The samples tested were taken from a depth of about 23 ft.

The Action of Inhibitors

THE addition of "inhibitors" to pickling acid greatly decreases the rate of attack on clean steel or iron, while at the same time permitting the rapid solution of the scale. In a paper read at the recent St. Louis meeting of the American Chemical Society, Messrs. E. L. Chappell, B. E. Roetheli, and B. G. McCarty state that the action of inhibitors has been given comparatively little theoretical study, and their work was undertaken to investigate some of the factors involved. This study indicates that the action of the inhibitor is directly related to the raising of the hydrogen over-voltage on steel, and gives comparative data for the action of a typical inhibitor on steel, wrought iron, cast iron, copper, and other materials. This relation is then described for a number of types of chemical substances which have inhibitive properties. A general theory of the mechanism of inhibitor action is suggested.

Determination of Lead in Small Amounts

At a recent meeting of the Society of Public Analysts, Dr. B. S. Evans read a paper on "A New Method for the Separation and Determination of Small Amounts of Lead." The method is based on the quantitative deposition of the lead on copper from a cyanide solution containing ammonium oxalate. As in the presence of some metals the deposit is not very adherent, a percolation apparatus containing copper filings is used. By working in the cold, the interference of tin, antimony, zinc, cadmium and nickel is eliminated; bismuth is deposited, but, in the amounts present in commercial coppers, does not interfere. The deposited lead is converted into sulphate and then into chromate, which is dissolved in nitric acid, and the chromate ion is determined colorimetrically by comparison with standard (N/100) potassium dichromate solution containing nitric acid.

Electric-Furnace Cast Iron

ALTHOUGH the cupola is the cheapest melting device for the production of molten iron under normal market conditions, for pig iron, coke, and clean cast-iron scrap there are conditions under which expense of melting is not the major factor, so that certain other advantages possessed by the electric furnace sometimes make it more desirable. The Department of Commerce of the United States Bureau of Mines states that a comprehensive investigation of the making of electric-furnace cast-iron has been completed by the Bureau at its Northwest Experiment Station, Seattle, Washington, in co-operation with the College of Mines of the University of Washington. The investigation involved a year's successful operation of a jobbing foundry making miscellaneous gray-iron castings from steel scrap.

Under the special conditions that make the electric furnace advantageous, this type of furnace need not necessarily displace the cupola, but can be used in conjunction with it. The ability of the electric furnace, and not of the cupola, to refine and to superheat iron, and the superiority in many ways of electric-furnace iron to cupola iron make the electric furnace advantageous under special conditions. In addition, the possibility of producing electric-furnace cast iron from cheap grades of ferrous scrap has brought the electric furnace into prominence.

Properties of the Product

ELECTRIC-FURNACE cast iron is stronger, tougher, and more dense than cupola iron, and a higher recovery of metal in casting can be obtained as a result of the higher pouring temperature, state C. E. Williams and C. E. Sims, in Technical Paper 418, just issued by the Bureau of Mines. Cast-iron scrap of high-sulphur content can be converted into high-grade

cast iron, low in sulphur, either by melting directly in the electric furnace or by refining molten metal from the cupola. Large additions of steel scrap may be used if desirable, or steel scrap can be used entirely and synthetic cast iron made.

In the electric furnace a superior iron, having about twice the strength of ordinary cupola iron, can be made. Transverse strengths of 5,000 to 6,000 pounds on standard bars of synthetic gray iron have been repeatedly obtained, and tensile strengths above 40,000 pounds per square inch are common. One of the outstanding characteristics of electric furnace gray iron is its resistance to impact of shock. These advantages in strength and toughness are due largely to the physical structure of the iron, which is fine grained and dense. The graphite exists in such small flakes that a piece of synthetic iron of the same graphitic carbon content as a piece of cupola iron will appear to contain less graphite. Although it looks whiter and harder than cupola iron, synthetic iron is soft and easily machined. A coarse-grained synthetic iron can be obtained only when the carbon and the silicon contents are exceptionally high. Ordinary synthetic iron is at least equivalent in strength to the so-called high-test iron and semi-steels of the cupola.

Removal and Reorganisation of Krupp's Works

DURING the past few years plans have been formulated in Germany to overcome the chief disadvantage of the Westphalian heavy industry of high transport cost by transferring as many iron and steel works as possible from the Ruhr to the area along the Rhine bank, where cheap water transport is available. The two large undertakings, Krupp's Steel Works and the Phönix concern are removing their workshops and foundries to more convenient sites. It is understood that the Krupp's Works at Essen will be closed, and that the firm proposes to extend its works at Rheinhausen. The Essen furnaces will be shifted northwards to the Rhine-Merke canal, and the chief workshops will in future be situated in Essen-Borbeck. In accordance with the peace treaty, the Essen works were converted for the manufacture of agricultural machinery, motor cars and similar products, and with the dismantling of the armaments plant it has not been found that the upkeep of the works is justified.

U.S. Copper Industry in 1927

THE marked features of the U.S. copper industry in 1927, according to the Department of Commerce of the United States Bureau of Mines, were a relatively maintained production, a decrease in imports of refined copper, an increase in exports of metallic copper, a decrease in total stocks and a falling off in domestic withdrawals. The average quoted price for the year, according to the American metal market, was 13 cents a pound. Stocks of refined copper available for consumption were 22,000,000 pounds larger at the beginning of 1927 than at the beginning of 1926. The small drop in refined copper output and the decrease in imports of refined copper made less copper available for consumption and together with the increase in refined copper exported, entirely offset the decrease in domestic withdrawals.

The smelter production of copper from domestic ores in 1927 as determined by the Bureau of Mines from reports of the smelters showing actual production for 11 months and estimated production for December was 1,696,000,000 pounds, compared with 1,740,000,000 pounds in 1926. The 1927 production is 2.5 per cent. less than that of 1926, but, with the exception of 1926, is the largest peace-time production on record. The estimated smelter production from domestic ores for December, as reported by the smelters, was 145,000,000 pounds, which is 4,000,000 pounds higher than the average for the 11 months preceding. The production of new refined copper from domestic sources, determined in the same manner as smelter production, was about 1,739,000,000 pounds, compared with 1,731,000,000 pounds in 1926. In 1927 the production of new refined copper from domestic and foreign sources amounted to about 2,318,000,000 pounds, compared with 2,322,485,000 pounds in 1926, a decrease of nearly 4,500,000 pounds, or 0.2 per cent. The production of secondary copper by primary refineries decreased from 225,118,000 pounds to about 216,000,000 pounds in 1927, or 9,000,000 pounds, so that the total primary and secondary output of copper by the refineries was a little over 0.5 per cent. lower in 1927 than in 1926, being about 2,534,000,000 pounds compared with 2,547,603,000 pounds.

Trade, Commerce, Finance: The Month in Review

From Our Market Correspondent

DURING the month of April, considerable interest has been aroused in the iron and steel industry on two occasions by the public utterances of members of His Majesty's Government on matters of direct importance to the industry. The first of these was the speech of the President of the Board of Trade, at the annual dinner of the National Federation of Iron and Steel Manufacturers in London. At that dinner there were gathered together representatives of every important iron and steel works in the kingdom, and as the President of the Board of Trade was the principal guest, it can safely be assumed that what he had to say was intended to be taken as an official statement to the industry.

Sir P. Cunliffe-Lister on Safeguarding

Although the state of the industry is now well known to everyone, the position was again very plainly described in the speech of the President-elect of the Federation in proposing the toast of His Majesty's Government. His words, however, did not in the slightest deflect Sir Philip Cunliffe-Lister from the line which has been marked out by the Government. He was there to tell his hearers that, as far as the present Government is concerned, there is not the slightest hope of safeguarding for the industry, and he fulfilled the object of his coming by telling them that in unmistakable language. The Prime Minister considers himself bound by the pledge he gave in 1925 not to introduce a general measure of protection to the steel trade, and he is evidently going to stick to that attitude. The truth is that the question of safeguarding for this particular industry is so beset with difficulties, that the Government prefers to let the employers continue their efforts to work out their own salvation, rather than raise the storm by putting a check on foreign imports.

Nevertheless, there is an unabated desire for some form of protection among the steel makers. The workmen in the steel works are just as desirous of protection as the employers, and this is shown by the fact that the Iron and Steel Confederation, the union representing the majority of the men employed in the works, has recently again passed a resolution urging the Government to give this much-needed assistance. However, in view of the definite statement of the President of the Board of Trade, it is as well not to indulge any hopes of such relief, at any rate for a year or two.

Sir Alfred Mond on Rationalisation

At the same dinner, Sir Alfred Mond made an alternative suggestion. He does not favour a tariff on foreign steel, but, instead, he recommends the steel makers to remedy their troubles by scrapping the plants in excess of the demand. He is of the opinion that we have too many steel works in this country, and he thinks that this fact should be faced boldly, and the surplus plants pulled down. In his speech he pointed out that this step had been taken by the chemical industries in connection with some factories, erected for war purposes, which were no longer needed.

There is, however, a great difference between the two cases. The chemical plants were built with the full knowledge that they might have to be discarded after the war, and consequently they were built on the cheapest possible lines. Such a policy could not be adopted in building steel works. They could only be built to last. At the same time, Sir Alfred's suggestion is not an idle one, and in the absence of such assistance as might be obtained from safeguarding, it is the only suggestion that will meet the difficulty; and if it is not adopted voluntarily, it may be enforced by financial stress.

Hopes of Rating Relief

Now we come to the second interesting item, the Budget. Its importance for the iron and steel trades lies in the proposals to give relief from the rates to the railways and the manufacturing productive industries. Briefly stated, the

proposal is to give a rebate of three-fourths of the amount paid in local rates by the manufacturers, and a large sum will be granted to the railway companies in relief of their rates, on the understanding that this relief is passed on in the shape of reduced rates of carriage for coal and coke, iron ore and limestone. There will thus be a cumulative effect of the reduction in the railway rates when we come to the finished products.

It is not yet clear exactly how the general rebate of 75 per cent. will operate. At first sight it looks very attractive, and will mean a considerable sum to the individual works, as most of them are now paying five or six times as much in local rates as they did before the war. The actual relief, however, may be affected by the new valuation which is to be made. It is rather disappointing to find that the proposed relief is not to become available until the end of 1929. A year and a half is a long time to wait, and it is not cheering to think that the steel trade will have to endure the present unsatisfactory conditions, or worse, for so long. It is to be hoped that, before the Budget is passed, amendments will be made which will ensure an earlier application of the rating relief.

Trade Conditions

Turning to the actual market conditions during the month, one is unable to report any change from the staleness which has been a feature of recent months. In keeping with this condition, the Birmingham Quarterly Meeting was held on Thursday of Easter week, and there was a very poor attendance. There was little or no business done. The Easter holidays caused a slight interruption in the normal course of trade, the stoppage being longer at some of the works owing to the shortage of orders.

There has certainly been no improvement in the general flow of business since Easter, and consumers are continuing their policy, which has now become almost settled, of buying only to cover immediate requirements. As far as one can see, there is no good reason to expect an improvement. The ship-building trade is not so good, and in consequence the steel makers on the North-East Coast report a falling-off in orders. In South Wales the tinplate trade is quite brisk, although the heavy steel trade in that district is no better than in any other part of the country. Continental competition is perhaps a little keener, but it is not acute, and there is not much buying.

State of Markets

The pig iron market has continued quiet. The makers have maintained their prices, not without difficulty, as consumers are still looking for lower prices. The foundries are not busy, and orders for foundry iron are not plentiful. The hematite market remains depressed. Most of the furnaces are working on old contracts. The East Coast makers report a somewhat better demand, but the prices are very unremunerative, and there are heavy stocks to be cleared.

In semi-finished steel, the competition amongst the home makers is very keen, and low prices are quoted for both acid and basic billets by makers who are short of orders. There is no actual official price, and the figure seems to be determined by the state of the order book. In finished steel there is no change. The works are still short of specifications for sections and plates. The railway companies have assisted a little by the orders for locomotives which they have placed with various makers, but the amount of steel required is relatively small. The official prices for sections and plates are unchanged, but there is no abatement in the competition for the uncontrolled materials.

There was an increase in the production figures for March as compared with February. The number of furnaces in blast increased by two, and the output of pig iron was 592,600 tons, compared with 550,800 tons in February. The production of steel amounted to 793,300 tons, compared with 764,400 tons in February.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Detinning

ACCORDING to Patent Application 282,779, by Q. Marino, of Paris, bearing the International Convention date December 27, 1926, tin scrap or the like is detinned by immersion for a few minutes at ordinary temperature in a bath of hydrochloric acid of 21° Bé, containing a salt or salts adapted to release chlorine from the acid, *e.g.*, sodium or potassium chromate, bichromate, or nitrate, or sodium, potassium, or ammonium chlorate. From the resulting solution of stannous chloride the tin is obtained either by precipitation by means of zinc or aluminium, or by evaporating to dryness, dissolving the residue in dilute sulphuric acid, and subjecting the solution to electrolysis to deposit the tin in spongy form. In the latter case a copper cathode and an anode of retort carbon or agglomerated plumbago are used.

Recovering Copper, Zinc, etc.

THE recovery of copper, zinc, and other metals from iron pyrites and other ores and liquors containing them is described with much detail by C. F. Schantz, of Berlin, in Patent Specification 285,662, dated March 12, 1927. To the liquor obtained by lixiviating the product resulting from roasting the pyrites under chlorination are added calculated quantities of sulphuric acid, copper oxide, and finely divided copper sufficient to precipitate all the copper and chlorine as cuprous chloride, the precious metals (silver, gold) as metals, and the lead as sulphate, leaving a pure sulphate liquor adapted for the recovery therefrom of the zinc. The cuprous chloride is separated from the precipitate by repeated extraction with an alkali chloride solution, and the copper is recovered from this solution by electrolysis, by cementation, or in galvanic elements. The zinc is recovered electrolytically or by precipitation as oxide for reduction in the usual way.

Refining Lead

LEAD is freed from zinc by passing the molten metal repeatedly through a chamber containing chlorine. At one stage of the process substantially pure zinc chloride is skimmed off, whereupon more chlorine is supplied, and the remainder of the zinc chloride is removed in admixture with lead chloride. The latter is separated and used for removing zinc from more of the molten lead. See Patent Specification 285,630, dated January 21, 1927 (E. C. R. Marks, a communication from American Smelting and Refining Co., of New York).

Electrolytic Processes

THE cathode of a furnace for the electrolysis of chlorides, *etc.*, of light metals, such as magnesium, calcium, or glucinium, comprises a number of suspended rods cooled at their upper ends, *e.g.*, by attachment to a water-cooled metallic ring. Such cooling results in the formation on the surface of the bath around the rods of a light crust which reduces the corrosive action of the chlorine. See Patent Application 284,678, by P. L. Hulin, of Grenoble, France, bearing the International Convention date February 3, 1927.

A method for producing electrolytically coatings of certain metals, such as chromium, nickel, molybdenum, or tungsten, or of alloys containing these, upon a base of iron or other metal, is described in Patent Specification 286,457 (Mellersh-Jackson), dated March 8, 1927, a communication from Siemens and Halske Akt.-Ges. of Berlin. The deposition is effected from a molten mass comprising a solution of the metal or alloy to be deposited, or of one or more compounds thereof, in one or more salts, *e.g.*, borates, sulphates, silicates, or cyanides of alkali or alkaline earth metals. The melting-point of the mass must be at least 100° C. below that of the metal or alloy to be deposited. When using borates or silicates, a deposition of boron or silicon in addition to that of the metal or alloy may be effected by employing a sufficient current density.

Tin

In Patent Specification 286,795, dated December 13, 1926, H. L. Sulman and H. F. K. Picard, of London, describe a process for the extraction of tin from its ores by a chloridising operation with volatilisation of the tin as chloride, followed by a further volatilisation of tin chloride by the application of steam to the heated chloridised material. The chloridising is

preferably effected by the action of dry hydrogen chloride upon an intimate mixture of the ore with carbon heated to 600–700° C. During the steaming operation the temperature of the material is preferably maintained above the volatilisation temperature of stannous chloride (603° C.). When a considerable amount of non-volatile chloride, *e.g.*, ferrous chloride, is produced in the chloridising operation, an incomplete conversion of the tin into chloride is allowable, as in that case chloridising of a further portion of the tin occurs during the steaming operation.

To recover tin from tin-plate scrap, a solution obtained by leaching the scrap with a solution of ferric and ammonium chlorides, or ferrous and ammonium sulphates, is electrolysed in iron-lined pits. Chlorine liberated at the anode may be allowed to act on further scrap contained in rotary drums above the electrolyte, and the ferric chloride may be produced by the action of hydrochloric acid on the scrap in presence of chlorine. See Patent Application 284,691, bearing the International Convention date February 5, 1927, by L. U. La Corsa.

Zinc

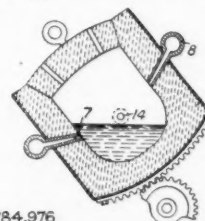
ZINC may be recovered from solutions of its sulphate or chloride by treating the solutions with a considerable excess of ammonia, and passing in carbon dioxide to obtain an easily-filtered granular precipitate containing zinc, carbon dioxide, and ammonia. In an example a lead-zinc ore, which has been freed from lead and silver as described in Specification 264,569 (see THE CHEMICAL AGE, Vol. XVI, p. 23 [Metallurgical Section]), is roasted and leached with 13 per cent. sulphuric acid. The solution, freed from metallic impurities by treatment with zinc powder, is treated with excess of an ammonia solution, and carbon dioxide is passed into it. The washed precipitate is ignited at 500° C., yielding substantially pure zinc oxide. See Patent Specification 287,186, dated September 18, 1926, by S. C. Smith, of London.

Zinc is deposited electrolytically from a zinc sulphate solution, containing 15–25 per cent. of free sulphuric acid, at a low current density (200–500 amps. per sq. metre). By the use of such an electrolyte a more thorough extraction by lixiviation from zinc-containing materials is permissible. See Patent Application 285,373, by I. G. Farbenindustrie Akt.-Ges., of Frankfurt-on-Main, Germany, bearing the International Convention date February 14, 1927.

Iron

ACCORDING to Patent Application 284,991, bearing the International Convention date February 7, 1927, by Vereinigte Stahlwerke Akt.-Ges., of Dusseldorf, Germany, propose to treat iron ores with chlorine or with chlorides, *e.g.*, hydrogen, magnesium, or ammonium chlorides, to produce ferric chloride, which is then reduced by hydrogen at 300–500° C. The chlorination is accelerated by using a pressure of 10 atmospheres or more, and in the case of arsenical or antimonial ores a preliminary chlorination at 100° C. is used to remove the arsenic or antimony.

According to Patent Application 284,976, by A. A. Frey, of Pittsburgh, U.S.A., bearing the International Convention date February 5, 1927, it is proposed to refine iron in the following three operations:—(a) The iron is melted under basic and reducing conditions in an open hearth or electric furnace, and the slag is removed; (b) the molten iron is heated under basic



284,976

and oxidising conditions, in a converter, and the slag is removed; (c) the product is treated in the converter with hydrogen or other reducing gas. Operations (b) and (c) may be carried out in the tiltable converter shown. For operation (b) this is tilted to the position shown, and air or oxygen is supplied through the tuyere 7. The converter is then turned to the upright position, and the slag is removed through the outlet 14. For operation (c) it is tilted in the other direction and the reducing gas is supplied through the tuyere 8.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ANALYSIS.—An improved rapid method for the determination of gases in metals, especially oxygen in steel. W. Hessenbruch and P. Oberhöffer. *Stahl und Eisen*, April 12, pp. 486-487 (in German).

CORROSION.—The action of salts on metals at high temperatures. B. Garre. *Korrosion und Metallschutz*, March, pp. 53-55 (in German).

The corrosion of copper and brass with regard to the condenser tube problem. V. Duffek. *Korrosion und Metallschutz*, March, pp. 56-58 (in German).

Cadmium deposits as protection against rust. W. Pfannhauser. *Korrosion und Metallschutz*, March, pp. 58-59 (in German).

The coating on iron electrodes in corrosion tests. W. van Wüllen Scholten. *Korrosion und Metallschutz*, April, pp. 73-74 (in German).

ELECTROMETALLURGY.—The production of the heavy metals by electrolysis in the molten condition. II. The production of iron, chromium, and manganese from oxides and silicates. G. Neuendorff and F. Sauerwald. *Zeitschrift Elektrochem.*, April, pp. 199-204 (in German). By the electrolysis of appropriate compounds, it is possible to obtain carbon-free iron, steel, and pig-iron. Chrome iron ore yields iron-chromium-carbon alloys. Manganese has only been obtained as a manganese-iron alloy poor in manganese.

GENERAL.—The effect of small additions of tin and cadmium on the properties of lead. J. Cournot. *Comptes Rendus*, March 26, pp. 867-869 (in French).

The significance of aluminium and its alloys for the chemical and food industries. H. Buschlinger. *Chemische Fabrik*, April 18, pp. 209-211 (in German).

The hydrogen over-voltage in alloys. M. G. Raeder and J. Brun. *Zeitschrift physikal. Chem.*, Vol. 133, Parts 1-2, pp. 15-30 (in German).

The significance of negative catalysis for the building up of protective paints. J. Scheiber. *Korrosion und Metallschutz*, April, pp. 82-86 (in German).

HIGH SPEED STEEL.—On the double carbide of high speed steel. A. Westgren and G. Phragmen. *Trans. Amer. Soc. Steel Treating*, April, pp. 539-554.

IRON.—Contribution to the knowledge of graphite in grey cast iron and its influence on hardness. P. Bardenheuer and K. L. Zeyen. *Stahl und Eisen*, April 19, pp. 515-519 (in German). Investigations on the dissolution of graphite, formation of structure, and separation of graphite. Dependence of mechanical properties of cast iron on the development of graphite. Influence of the temperature of casting on the development of graphite and the hardness of the cast iron.

Examples of peculiar graphite crystallisation in crude and cast iron. H. Pinsl. *Stahl und Eisen*, April 12, pp. 473-477 (in German).

METALLIC COATINGS.—Metallic coatings. M. Schlötter. *Korrosion und Metallschutz*, April, pp. 74-82 (in German).

RESISTANT METALS, ETC.—Acid-resistant metals and alloys. W. Rohn. *Korrosion und Metallschutz*, March, pp. 49-53 (in German).

SINGLE METALS.—The behaviour of a single crystal of α -iron subjected to alternating torsional stresses. H. Gough. *Proc. Roy. Soc. A*, April 2, pp. 498-534.

STEEL.—A contribution to the theory of hardening and the constitution of steel. Z. Jeffries. *Transactions Amer. Soc. Steel Treating*, March, pp. 369-404.

Fatigue tests of carburised steel. H. F. Moore and N. J. Alleman. *Transactions Amer. Soc. Steel Treating*, March, pp. 405-419. Presents the results of fatigue tests and static tension tests of carburised steel. The steels studied were a plain carbon steel, a nickel steel, and a chromium-nickel steel. In general, the results suggest that carburising, followed by suitable heat treatment is a promising means of increasing the fatigue strength of steel as well as an effective means of increasing surface hardness.

What happens when high speed steel is quenched? B. H. de Long and F. R. Palmer. *Transactions Amer.*

Soc. Steel Treating, March, pp. 421-434. High speed steels tempered (drawn) at 1,100° F. before being allowed to become sufficiently cold in the quench are brittle due to mixed structures. Straightening of high speed tools may be readily carried out at 700-1,300° F. A method is indicated for determining whether high speed tools have been quenched to a sufficiently low temperature before tempering.

Armco ingot iron. I and II. Reid L. Kenyon. *Transactions Amer. Soc. Steel Treating*, February, pp. 240-269; March, pp. 435-472. Includes a description of the material, its chemical analysis, microstructure after various treatments, etc.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case, the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

FRODINGHAM IRON AND STEEL CO., LTD.—Registered March 16, substituted security (supplemental to Trust Deeds dated October 11, 1917 and June 9, 1925, securing £1,000,000 debentures); charged on premises comprised in a certain lease. *£694,910. November 22, 1927.

MIDLAND COAL, COKE AND IRON CO., LTD., Newcastle (Staffs).—Registered March 20, Trust Deed dated March 2, 1928, securing £50,000 further prior lien debentures (supplemental to Trust Deed dated July 7, 1919); charged on properties comprised in original deed, also general charge. *£591,044. March 1, 1928.

MILLOM AND ASKAM HEMATITE IRON CO., LTD.—Registered March 16, Trust Deed dated March 6, 1928 (supplemental to Trust Deed dated August 1, 1919), securing £98,570 already secured by principal deed; charged on quarries, etc., at Redhills, Millom. *£99,270. November 28, 1927.

RENISHAW IRON CO., LTD.—Registered March 19, £60,000 1st debenture, to Bank; general charge. *Nil. October 20, 1927.

UNITED STEEL COMPANIES, LTD., Sheffield.—Registered February 25, conveyance (supplemental to Trust Deed dated April 19, 1918, securing £500,000 (not ex.) C debenture stock); charged on land and drill-hall at Arundel Road, Trecton. *£2,609,388 19s. 3d. November 7, 1927.

ASHMORE, BENSON, PEASE AND CO., LTD., Stockton-on-Tees, ironmasters.—Registered March 30, £50,000 debenture to Power Gas Corporation, Ltd., Parkfield Works, Stockton-on-Tees; general charge. *£100,000. December 19, 1927.

PARTINGTON STEEL AND IRON CO., LTD., Manchester.—Registered March 30, £100,000 debentures, to bank; general charge. *£1,471,325. October 13, 1927; also registered April 4, £100,000 debenture to Sir W. G. Armstrong, Whitworth and Co., Ltd., Newcastle-on-Tyne; general charge. *£1,471,325. October 13, 1927.

Satisfactions

BWANA M'KUBWA COPPER MINING CO., LTD., London, E.C.—Satisfaction registered April 10, £300,000, registered September 16, 1925, and April 10, 1928.

MIDLAND COAL, COKE AND IRON CO., LTD., Newcastle (Staffs).—Satisfaction registered April 10, £28,000, registered July 11, 1913, and March 23, 1915.

London Gazette, &c.**Company Winding Up Voluntarily**

BARRONIA METALS CO., LTD. S. Croft, of Jackson, Pixley and Co., Chartered Accountants, 58, Coleman Street, London, E.C.2, appointed as liquidator, April 3.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

The Uses of Cadmium.—(1)

By a Metallurgical Correspondent

This article, written by a metallurgist who has specialised on the subject, is intended to give a cursory survey of the present applications of cadmium in the arts and industries. The numbers in brackets indicate references given at the end of the article.

DURING the war period, when there was a general shortage of tin, it was proposed to use cadmium as a substitute for part of the tin in solders. But upon enquiry it was found that, if all of the possible sources of cadmium were utilised, the output would still be small in comparison to the 19,000 to 20,000 tons of tin annually consumed in America for solders, even if due allowance were made for the fact that 1 lb. of cadmium can replace 3 to 5 lb. of tin. Thus it is seen that one industry alone could absorb the whole cadmium production of the world, leaving no part for other purposes. As it happens, however, the use of cadmium in this particular direction, now that tin is again available, has very much diminished, and cadmium is free for other uses. It is probable that in the course of time, application will be found for all of the cadmium that can be produced, although such is not yet the case.

Cadmium, and cadmium compounds, were declared contraband of war by nearly all belligerents in the European war, hence there must be military uses for the material, but that there is not much authoritative information regarding these uses is not altogether surprising. About 1896, the German Imperial Government used large quantities of cadmium in the artillery and pyrotechnics departments, and again in 1910 Germany wished to import about 11,000 lb. of cadmium monthly for two years, a quantity representing about twice the total output of the United States for any pre-war year.

Alloys Containing Cadmium

Probably one of the most important future applications for metallic cadmium will lie in its addition to copper for drawing into telegraph, telephone, and power transmission wires. For such purposes, besides hard-drawn copper wire, a large number of brasses and bronzes are on the market, and are used more or less as electrical conductors because of some special property each one possesses. Although these special alloys have, compared to hard-drawn copper, a higher tensile strength and annealing temperature, and a greater resistance to abrasion, their electrical conductivity is much lower. But the discovery by Smith that wire drawn from copper containing a small amount of cadmium possesses all the beneficial properties of such wires in addition to an electric conductivity not much below that of hard-drawn copper, has led to considerable experimentation, and in some places to adoption of the wire for electric tramway systems.

Though it is a little early yet to make forecasts, it seems highly probable that such wire will entirely eclipse all other special brasses and bronzes which in the past have been employed for purposes where durability, tensile strength, hardness, high annealing temperature, and electrical conductivity are necessary features.

Copper-Cadmium Alloy for Electrical Conductors

The results of laboratory tests by Smith (1) on the tensile strength of hard-drawn copper-cadmium wire (No. 12, B. and S. gauge, about 0.081 inch diam.) and of conductivity experiments on annealed samples indicate that the electrical conductivity varies in inverse proportion to the cadmium content, showing a loss of rather less than 1 per cent. in conductivity for each 0.1 per cent. of cadmium added. The breaking strain increases slightly as the cadmium content rises, until 0.6 per cent. is reached, after which increase in tensile strength is much more marked.

The annealing temperature of copper-cadmium wire is raised as the cadmium content is increased, and a wire containing 1.10 per cent. will withstand a temperature of 260° C. for half an hour with only slight evidence of softening, while pure copper wire is dead soft after the same treatment. The cast alloy containing 1.10 per cent. of cadmium is 20 to 22 Brinnell numbers harder than cast copper. The new alloy wire hence provides electric tramway engineers with a conductor which combines the advantages of hard-drawn copper and the bronzes, and has properties comparable with the pliability of annealed electro-copper, the conductivity of hard-drawn copper, and the higher breaking strain and wearing properties of phosphor-bronze, silicon bronze, and phospho-electric wire.

Its physical characteristics, compared with the British specification for hard-drawn copper wire (30 gauge) are as follows:—

	HARD-DRAWN COPPER.	CADMIUM- COPPER.
Breaking strain, tons per sq. in.	24	29
Elongation, in 10 in.	3% min.	4.2%
Torsion test—twists in 10 in.	9	36
Resistance—per 1,000 yards	0.2253 ohm.	0.2350 ohm.
Bending—to right angle and back.	4 times	7 times

Attention is directed to the unique properties disclosed by the torsion and bending tests, which make the alloy wire altogether superior to hard-drawn copper for general handling purposes; for instance, bending into fittings, straightening, re-bending, etc. It will be seen from the above test figures that these advantages are not obtained by any softening of the wire, or by any sacrifice of tensile strength or elongation.

Alloys containing cadmium are used for the manufacture of hair-springs for watches and clocks. They have many of the attributes of steel, but do not rust, and are non-magnetic. The following two compositions have been recommended:—

Platinum	67.75 to 59.25 per cent.
Copper	18.00 to 16.88 "
Nickel	18.00 to 18.25 "
Cadmium	1.25 "
Cobalt	2.00 "
Tungsten	1.87 "

Or as follows:—

Aluminium	90.00 to 96.50 per cent.
Nickel	0.50 to 1.00 "
Antimony	0.50 to 5.00 "
Cadmium	2.50 to 4.00 "

Cadmium is also used with the cerium earth metals for the production of pyrophoric alloys, which contain 30 to 40 per cent. of zinc with some cadmium, etc., in the so-called "Misch" metal. It has been estimated that 200 tons of cerium earth metals are used annually for this purpose, so that the cadmium consumption in this direction is small (2).

A variety of mixtures to be used as solders have been proposed, among which are the following:—

Lead-cadmium.
Zinc-cadmium.
Tin-cadmium.
Lead-cadmium-tin.
Lead-cadmium-zinc.
Bismuth-cadmium tin, and
Lead-cadmium-bismuth.

Of these, probably lead-cadmium-tin and lead-cadmium-zinc have proved the most satisfactory solders from all points of view and for general purposes. The two mixtures last-mentioned have low melting points, and are used for soldering tin, lead, or Britannia metal.

Certain mixtures of cadmium with gold give green alloys, which, like the copper-cadmium-silver-gold mixtures, have a limited application in the manufacture of jewellery.

Silver-cadmium alloys are in many respects eminently suitable for the manufacture of domestic articles, possessing, as they do, remarkable malleability which permits of spinning, rolling, and drawing. Such alloys have also been electro-deposited under the name of "Arcas" plate.

Modern "stain-resisting" silver contains cadmium. A considerable amount of cadmium is consumed in the manufacture of sterling silver, in which about 0.5 per cent. is employed to deoxidise the bath before pouring, and to impart malleability to the metal; for a similar purpose, and with good results, it is also added to silver solder.

Numerous alloys for bearings, containing cadmium, have been patented, for which is claimed a very low coefficient of friction.

Fusible Alloys

Bismuth-lead-cadmium, bismuth-tin-cadmium, and lead-tin-cadmium alloys are used to a certain extent under the name of fusible alloys, but the quaternary mixture is more generally employed when a very low melting-point is desired.

Fusible alloys have a limited use for fusible plugs in fire-extinguishing and safety devices, electric fuse wires, clichés, and to a fairly large extent in newspaper printing, where metal copies are taken from the impression stamped in papier maché by a harder type set. A very fusible alloy is prepared by addition of mercury to the quaternary mixture, and this is used by anatomists for taking casts of the human body. The recent increase in the use of the wireless telephone has resulted in a large consumption of fusible alloy for the settings of crystal detectors in receiving sets. Wood's alloy, of composition cadmium 13, bismuth 48, lead 26, and tin 13, is the one generally employed, as the melting point of this (60° C) is suitable for the purpose (3).

Cadmium is added as a deoxidant to molten aluminium and nickel alloys before casting. Cadmium is the most beneficial of the common metals, when alloyed to the extent of about 5 per cent. with aluminium, to be used for the manufacture of powder. The 5 per cent. alloy takes a high lustre and reflects a lighter yellow than pure silver. The cadmium also assists in preventing atmospheric corrosion of the powder when used as a paint for decorative or protective purposes (16).

Cadmium Plating

The electro-deposition of cadmium and cadmium alloys has been the subject of considerable research, and as a result the best working conditions have been arrived at. The process has at the present time no great field of utility, but undoubtedly offers promise of expansion. [The new Ford car is said to be protected by cadmium plating.—Editor, C.A.] The deposited coating has almost as white an appearance as pure silver and resists tarnishing for a longer period, or, when suitably prepared, cadmium-plated articles may have an antique silver appearance. Electro-plating with cadmium (it being a better rust-resister than nickel) might replace nickel for this purpose were there less difference in price; or it has been suggested that, as cadmium tarnishes more readily than nickel, the latter metal might be deposited on a first coat of cadmium. Attempts have been made under the direction of Prof. C. H. Desch to use cadmium-plated aluminium aeroplane parts, with a view to preventing corrosion, but it was tentatively decided that the increased weight rendered the process inapplicable (4).

Cadmium is electro-plated on to terminals of primary and secondary cells, as it is resistant to attack by sulphuric acid; small sporting shot and steel jackets of rifle bullets are also coated in this way, wear upon the barrel of the gun being thereby diminished. The silver-cadmium alloys which are plated on to domestic articles are less easily tarnished than silver plate, and up to 25 per cent. of cadmium may be employed in such alloys without affecting the colour of the deposit (5). For the plating of the interior part of telephone apparatus, in place of nickel, an alloy of cadmium and tin is used, the proportion of cadmium usually being from 20 to 30 per cent.

The Udylyte Process

Very recently the Udylyte process, which embodies electro-plating of cadmium and subsequent heating in an oven for several hours at 150° C. to 200° C. (whereby the cadmium coating is alloyed with the metal of the article coated) has been put into operation. The process has been applied to rust-proofing locks, hardware, kitchen cabinet and refrigerator trimmings, automobile parts and accessories, and such wire products as screen wire, wire ropes, fence and piano wire. The plating solution employed is sodium cyanide saturated with cadmium. Metallic cadmium anodes are mentioned in the patents, but in practice graphite or steel anodes are used, because, being insoluble and non-polarising, they allow of a constant current density being maintained.

The advantages claimed for the electro-deposited and baked cadmium coat are thinness, freedom from peeling, more effective rust protection owing to the alloy formed, adaptability to various finishes from bright to soft satin or French grey, and adaptability to further electro-plating, as with nickel, copper or brass. In 1921 the Udylyte process (U.S. Patent 178,422, June, 1923) was installed at 18 plants in the United States, and by the end of 1922 more than 50 plants were in operation, and new installations were proceeding at the rate of six or eight a month. Consumption of cadmium oxide in this process at the end of 1922 was at the rate of about 1,500 lbs. a month.

Cadmium in Ammunition Manufacture

Cadmium as metal has limited application in one or two special directions; it is, not, however, because of unsuitability that the metal is not more extensively used, but because of the relatively high cost. During the late war, small arms ammunition was provided with a cadmium band on the hard jacketed cartridge ball, which then takes the rifling with little wear on the barrel, and thus prolongs the life of the gun; for this purpose large quantities of cadmium were exported to Germany before the war. Sporting shot and rifle bullets are coated by electro-deposition.

Electrical Apparatus

A primary cell capable of giving a large ampere-hour output at a low but constant E.M.F. was described by Edison (6) in 1900. The cell had a cadmium-copper oxide combination in an alkaline electrolyte, and was really reversible, and not subject to the defects attendant upon cells with the zinc-copper oxide combination.

Finely divided metallic cadmium prepared by deposition upon a platinum wire from a solution of cadmium sulphate constituted the active material for the negative electrode. After washing, this material was packed into pockets stamped in perforated iron plates. The metal oxidises upon discharge, but does not then dissolve in the electrolyte, so in this respect it behaves more like a lead negative in an acid solution than a zinc negative in an alkaline one. The electrolyte recommended was a 10 per cent. solution of sodium hydrate. This cell quickly fell into disfavour when the iron-nickel oxide combination, also invented by Edison, was put upon the market.

Alkaline accumulators are now in use, and recently a new process for making the plates has been described by Forseke and Achenbach. According to this, cadmium is obtained in finely divided form as a spongy precipitate from a solution of a cadmium salt. In order to obtain it, zinc powder is added to a solution of cadmium chloride; the precipitated spongy cadmium, mixed with zinc powder, and a small amount of oxide of mercury, is then spread upon suitable support for making the battery plates. Such porous cadmium electrodes are used in a caustic soda or potash bath, against a nickel electrode. At the first charging by current, the mercury oxide is reduced to the metallic state and the mercury then envelops the particles of cadmium and zinc; on discharge, the zinc dissolves out, while the cadmium becomes oxidised and the mercury remains unaffected. The zinc thus remains only temporarily in the mass and aids in rendering it porous (7).

Alkaline accumulators (2) have certain distinct and important advantages over ordinary lead cells, one of which is that they may be completely discharged or allowed to remain charged, but not in use or under supervision for any length of time, without harmful results.

The cost ruling at the present is about three times as great as that of lead cells of the same ampere-hour capacity, the

cadmium being an important item in the expense of manufacture. If the price of cadmium can be reasonably reduced, there is a promising field for its application in this direction.

A report upon three lamps—the Pearson Nife Miner's Lamp (Jungner cell), the Worsnop Lamp, and the Wolf Lamp—prepared by Riley, Harbord and Law (2) is interesting in this connection. All three lamps are of Edison type, having an alkaline electrolyte, a positive nickel plate, and a negative plate, composed of finely divided iron and cadmium contained in a thin perforated metal case. The filling of the negative plates of the Pearson Nife battery contains 51.6 per cent. to 63.2 grms. (about 2.3 ozs.). The negative plates in the Worsnop lamp contain 47.7 per cent. of cadmium, the total weight amounting to 70 grms. (about 2.4 ozs.). The Wolf battery, which is a smaller one, and only carrying two negative plates as against the four in the other batteries, contains 74.5 per cent. of cadmium, the total weight amounting to 42 grms. (1.5 ozs.)

Light Filaments

One of the new uses for metallic cadmium is in the manufacture of tungsten electric light filaments. An alloy of 42 per cent. cadmium, 53 per cent. mercury, and 5 per cent. of bismuth, is impregnated with tungsten powder, about 30 per cent. of the whole; this is accomplished by heating and grinding in a mortar. The mixture is made into wire by the

extrusion process, as used in the lead-pipe manufacture, and is then passed through a die. It is finally heated to drive off the alloy and finished by heating in a vacuum to render the tungsten solid (8).

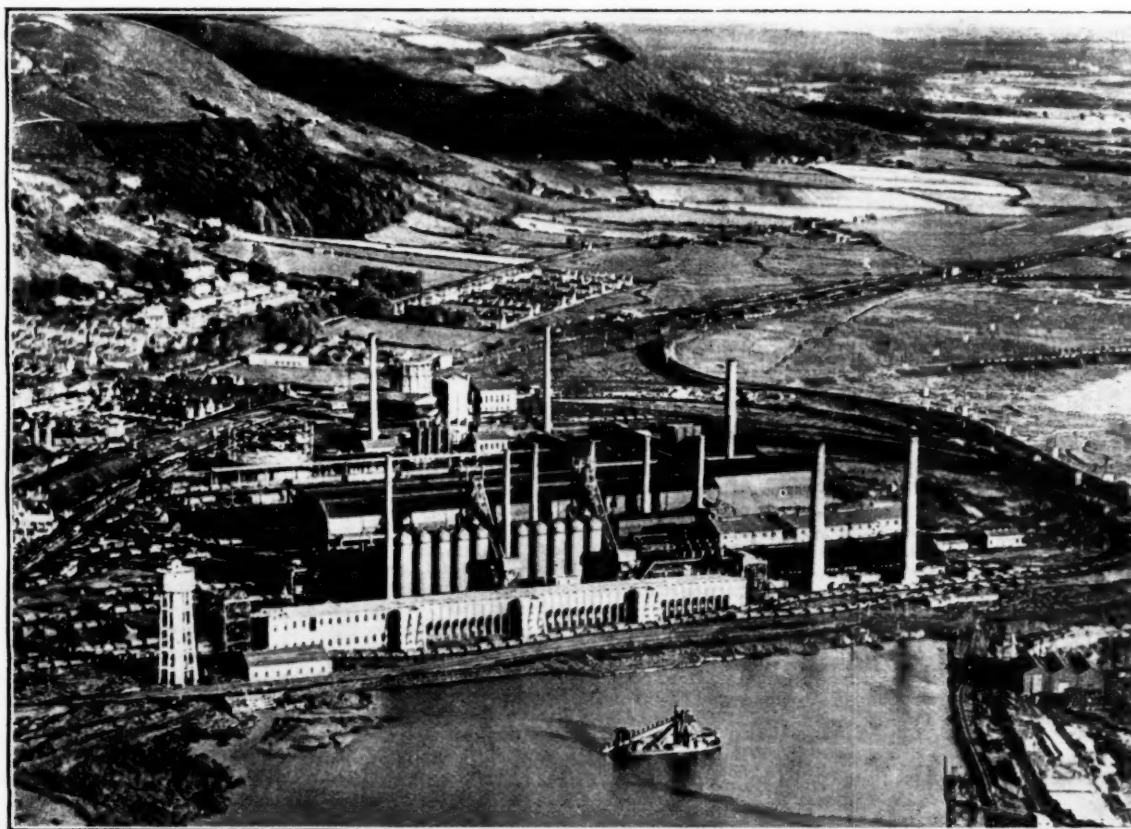
Mercury-cadmium alloys have an important application in the manufacture of standard cells, of which they form one of the principal components. A standard cell is one from which the electro-motive force is constant and independent of all local conditions; the principal use is for standardisation and testing.

(To be concluded.)

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Shipment and Re-erection of Steel Works



Central Aerophoto Co.

THE MARGOM STEEL WORKS, ONE OF THE MOST MODERN OF BALDWIN'S MILLS IN SOUTH WALES, WHICH IS TO BE TAKEN UP AND SHIPPED TO AUSTRALIA, THERE TO BE RE-ERECTED TO OPERATE FOR A COMPANY CONTROLLED BY BALDWIN'S, DORMAN LONG, & HOSKINS.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Institute of Metals: Visit to U.S.

At a general meeting of members of the Institute of Metals held in London on May 8, the following invitation was presented on behalf of the American Institute of Mining and Metallurgical Engineers, by Mr. W. M. Corse, honorary corresponding member to the Council for U.S.A.: "Having in mind the close similarity in field of the Institute of Metals and of the Institute of Metals and Iron and Steel Divisions of the American Institute of Mining and Metallurgical Engineers, and believing firmly that science knows no boundaries, and that by additions from many sources to the common pool of knowledge is the latter extended and deepened to the mutual benefit of all contributing, and that by international visits personal and professional bonds are built up that enhance the usefulness and prestige of professional men at the same time that they operate to strengthen the natural ties of history and ancestry between our two peoples.

"Now, therefore, on behalf of this Institute and by authority of its Board of Directors, I take pleasure in extending to you a most cordial invitation to visit and meet with us in this country at such time in 1932 as may be mutually found to be convenient.—G. O. Smith, President, American Institute of Mining and Metallurgical Engineers."

The president of the Institute of Metals, Dr. W. Rosenhain, F.R.S., suitably acknowledged the receipt of the invitation, and indicated that it would be gladly accepted by the Institute. It is understood that a good attendance of members at the proposed meeting in the United States is expected, as the ample notice of the date of the meeting will enable many persons to make the necessary arrangements to cross the Atlantic who could not do so were such a trip arranged at short notice. The Council are endeavouring to arrange for an inclusive fare of about £100 to cover the entire cost of the trip. This, it is expected, will be of about five week's duration, and will take place in the autumn, both Canada and the United States being visited. Further particulars can be obtained on application to Mr. G. Shaw Scott, M.Sc., Secretary, Institute of Metals, 36, Victoria Street, London, S.W.1.

The Autumn Meeting

THE Council of the Institute of Metals also give preliminary details of the previously announced Annual Autumn Meeting, which, thanks to the very kind invitation of members residing in the Liverpool district, will take place in Liverpool from Tuesday, September 4, to Friday, September 7. An influential reception committee has been constituted and is presided over by Professor C. O. Bannister. It is hoped that the meeting, which is the first to be held in Liverpool, will attract a large number of members. Members will assemble in Liverpool on Tuesday, September 4, during the afternoon of which day the office of the honorary local secretary, Mr. H. F. Richards, will be open for the distribution of tickets and badges. This office will be situated in the Adelphi Hotel. In the evening, the Seventh Annual Autumn Lecture will be delivered in the University by Mr. F. G. Martin, B.Sc., on the subject of "Non-Ferrous Metals in the Shipping Industry."

On Wednesday, September 5, the morning will be devoted to the reading and discussion of papers. Afterwards, members and their ladies will be entertained to luncheon by the reception committee at the Adelphi Hotel. The afternoon will be devoted to visiting works of interest in the neighbourhood. In the evening an entertainment will be arranged in the Adelphi Hotel. On the morning of Thursday, September 6, further papers will be presented for discussion, the afternoon being devoted to a visit to the Gladstone Dock and to a large liner. In the evening there will be a reception by the Lord Mayor (Miss Margaret Beavan, J.P.), at the Town Hall. For Friday, September 7, an all day tour will be arranged. A ladies' reception committee has been appointed to provide for the entertainment of lady visitors, especially during the mornings of September 5 and 6.

Non-Ferrous Research Association

THE annual report of the British Non-Ferrous Metals Research Association for 1927 (pp. 44) has just been issued. Expenditure on experimental work during the year amounted to

£20,000, as compared with £600 in 1920. One of the most important of recent advances is the establishment of a new "Development Section," which, when a suitable staff has been mobilised, will have the purpose of fostering, in close co-operation with the research workers of the Association, the application in works of the results of scientific research. With the growth of the work of the Association, a considerable increase of subscriptions and of support by the industry is required. The Department of Scientific and Industrial Research has shown its confidence in the Association by a generous revision of the terms of its grant for the years 1927, 1928, and 1929, conditional on the Association making greater efforts to strengthen its position. A detailed notice of the report and of the annual meeting of the Association appeared in THE CHEMICAL AGE of May 26, on p. 504.

The Institute of British Foundrymen

ALTHOUGH the annual Convention of the Institute of British Foundrymen, to be held this month in Leicester, occupies four days (June 12-15), the programme of papers down for reading is much shorter than that of the Iron and Steel Institute last month, which was spread over two days only. On May 14-18, the American Foundrymen's Association held its meeting in Philadelphia, while a few days before the Society of Steel Treating held its second annual conference at Lafayette, Indiana. The programme of the Foundrymen's Association was very long indeed; that of the Steel Treating short, but very wide in scope. There is much to be said for the short paper or the open discussion on a limited range of subjects, especially at annual meetings and conventions which members attend, it may be believed, as much for the sake of meeting one another in social intercourse as for the discussion of problems. That, with most of them, goes on automatically throughout the session; unduly crowded programmes on special occasions invariably fail to accord the time really necessary for a really good discussion. The Iron and Steel Institute, with its two meetings a year, is handicapped in this respect, useful papers being crowded out or else inadequately discussed. The Institute of British Foundrymen is wise in having but six papers, to which, in the time at its disposal, it will be possible to do justice. The papers are, moreover, of the practical kind, by practical men, and this too is an advantage. Five of the papers relate to iron, steel, and malleable foundry matters; the sixth deals with "Aluminum Casting Alloys," and is by Mr. G. Mortimer, whose experience and authority few will challenge.

American University Research Work

No invidious comparison need be drawn, however, from the way the councils of our various institutions draw up their programmes, nor between British and American bodies in this respect. From another point of view, however, it would seem most desirable that research work done at British universities should be published and rendered available, as it is by some of the leading universities in America. The Bulletins of the Engineering Experimental Station of the University of Illinois are examples of the kind of publication which one could wish to see British universities engage in more often. The admirable Woolwich Arsenal Memoirs are the only thing of the kind in this country. The reports of the various research associations themselves are available only to subscribers. Two bulletins recently issued by the Illinois University exemplify the admirable functions served by the Engineering Experimental Station. They deal with surface tension in molten metals and with fatigue failure in copper respectively. Surface tension phenomena are of the very greatest importance in determining the behaviour, the composition, and the subsequent cooling of molten metals and alloys. As the bulletin on "The Surface Tension of Molten Metals," by Mr. Earl E. Libman, says: "the greater part of the scientific world is investigating the structure of the atom and molecule. The property of the cohesion of fluids (and of solids as well) is intimately connected with atomic and molecular structure, and any knowledge gained concerning surface tension, which is a direct result of those cohesive forces, is a step in the solution of this great problem."

Surface Tension Phenomena in Molten Metals

MR. LIBMAN treats his subject mathematically, as is inevitable, but his reasoning is clear, and the paper can be read with benefit even by those unable to follow, step by step, the mathematical formulæ with which it is accompanied. Work on the surface tension of metals having a high melting point is complicated by the difficulty of ascertaining exactly what goes on in the necessarily opaque vessels containing them, and of preventing surface contamination of crucial surfaces, the purity of which is an essential condition to obtaining accurate results. Alundum crucibles embedded in pure calcined alumina were used, the furnace housing being of cast aluminum treated with water glass and veneered with an aluminosilicious compound to exclude air and ensure a good vacuum. The experiments were confined to ascertaining in the first instance the capillary constant of chemically pure copper, remelted and treated with hydrogen to ensure complete deoxidation. This notwithstanding, the copper gathered impurity of the order of 0.019 to 0.11 per cent. in the course of the manipulations. The most careful observations by X-ray and other methods established, however, data for comparative deductions respecting the behaviour of the metal, from the stage of greatest attainable purity to the degree of contamination actually recorded. With 0.019 per cent. of impurities present, the corrected values of the capillary constant varied from a minimum of 0.301 at 1093° C to 0.295 at 1318° C.

Fatigue Failure in Copper

BULLETIN 37 of the Illinois University, by H. F. Moore and F. C. Howard, embodies the metallographic study of the path of fatigue failure in copper. Rolled copper (Cu 99.895 per cent.) and cast copper (Cu 99.84 per cent.) were employed in the experiments, after various heat treating, pickling and drawing operations. The endurance limit of pure rolled, annealed or cold-drawn copper is approximately 10,000 lb. per sq. in. Fatigue cracks were developed by subjecting specimens to 250,000 cycles of reversed flexural stresses of 15,000 lb. per sq. in. Complete fracture was not attained under these stresses. Photomicrographs comprising magnifications up to 11,500 are given in the report. Three types of grain were identified at $\times 840$ in drawn and annealed copper, unstressed: a laminated structure; a "herring-bone" structure; and a "mottled" grain. The herring-bone structure is attributed to the action of the nitric acid used in etching on the material between, or along, cleavage planes. A high ($\times 11,500$) magnification of the stressed material appears to indicate that a grain has begun to break up along planes at right angles to the main cleavage planes, the conclusions being drawn that there is a set of secondary cleavage planes at right angles to the primary cleavage planes, and that annealing may not only fail to remove evidences of strain within a crystal, but also fail to "heal" a grain which has started to disrupt. No change in the vicinity of the crack appears to take place in the crystalline structure. In the copper under investigation there were so few inclusions that any tendency, such as Lucas detected in "Armco" iron, for a fatigue crack to proceed from inclusion to inclusion, could not be traced.

Nitrogen in Metals

AMONG the impurities in metals of which we know less than is desirable for the proper control of metallurgical operations and ultimate effects, are the gases. This is due to the difficulties attending their complete exhaustion, and to those accompanying their accurate estimation. The latest scientific paper of the Bureau of Standards, Washington (No. 563, "Gases in Metals"), by L. Jordan and J. R. Eckman, deals with the determination of nitrogen by fusion in a vacuum. A high-frequency vacuum furnace is employed; the gases, with the exception of the noble elements of that nature, are absorbed in calcium vapour, the resulting calcium nitride being dissolved in hydrochloric acid with the formation of an ammonium salt from which ammonia is subsequently distilled and absorbed in standard acid. This method, compared with the usual acid solution method, gives higher values, and also determines any "uncombined" nitrogen present in a metal. The method and apparatus employed are described. A number of analyses of samples of iron and steel, ranging from electric arc "weld metal" to 4 per cent. silicon steel are given.

By the ordinary acid solution process, for example, only 0.002 per cent. of nitrogen was found in a cast iron sample, whereas by vacuum fusion 0.006 per cent. was found. In metallic nitrides the disparity is even greater, and much higher results are given by the fusion method. The absorption and recovery of nitrogen by the method described in the paper are more efficient and accurate than by any other method customarily employed.

Titanium in Bauxite Ores

TITANIUM is a very frequent constituent of bauxite, and is sometimes present in quantities worth recovering. A flotation process for the purpose has been the subject of one of the "Reports of Investigations" of the Bureau of Mines, Washington. The ores which were the subject of the experiments were American bauxites from Alabama, Arkansas, Georgia, Mississippi, and Tennessee, the highest in titanium being the Alabama and Tennessee samples, which contained 2.9 per cent. of TiO_2 . The specific gravity of this constituent lent itself fairly well to separation by flotation, and the recovery would be easy but for the fact that it occurs distributed at random amongst other mineral constituents of the ores. When there is much clay present, little flotational selection is shown. The method appears, nevertheless, to have some useful industrial possibilities.

Detection of Flaws in Castings

By the use of γ -rays so penetrating that they will pass through pieces of metal fifteen inches thick, the Russian State Radium Institute of Leningrad has effected a marked improvement in the examination of thick metal castings, etc. Examination in this way, when compared with the normal X-ray investigation, possesses several distinct advantages. It is cheaper, since the radium lasts indefinitely; large and expensive photographic plates are unnecessary, since the rays which pass through the metal are detected by a special sensitive electroscope, and an automatic record can be taken which may be filed for reference. Another very distinct advantage is that the time required may be cut down to a couple of minutes for a large casting, whereas with X-rays an exposure of the order of several hours might be required, even when the metal is not much more than two or three inches thick. The apparatus is very simple; a glass capsule with the radium preparation is inserted into a deep hole bored in a large ingot of lead; all rays except the strong, narrow beam passing along the bore are stopped. The beam, after passing through the casting, encounters two filaments electrically charged and enclosed within a copper cage. So long as no ray penetrates the metal, the air space between the filaments and the cage acts as an insulator. As soon, however, as the γ -rays get into the cage, the air is ionised and a current flows from the filaments to the cage, then through the galvanometer and back to the battery.

Bureau of Information on Nickel

A PAPER on "The advantages, applications, and technology of nickel cast iron," has just been published by the Bureau of Information on Nickel, Ltd., of 2, Metal Exchange Buildings, London, E.C.3. Other papers published by the Bureau deal with the applications of nickel and nickel alloys, and nickel plating, while the issue of others on nickel alloy steel, nickel in brass and bronze, heat resisting alloys, etc., is planned for the present year. Those known to be especially interested in any particular subject relating to nickel are kept regularly informed by the Bureau of the latest published information on that subject. The services of the Bureau entail no charge or condition, and it is performing a very useful function.

Heavy U.S. Steel Imports

It appears that this country is by no means the only one where imported iron and steel are a menace to the home industry. Seven cities on the Atlantic seaboard of the United States are taking steps to fight against the importation of foreign steel. Within recent months builders there, who buy at the lowest price, have imported 200,000 tons from Europe, and it is represented that 90 per cent. of the steel used for structural work in New York is coming from abroad. One way to secure its exclusion, it is urged, is to prove that foreign-made steel is not so good as American, and for this purpose Columbia University has been asked to make scientific tests. There is also an appeal, not very effective, apparently, to native patriotism to help home industry.

Trade, Commerce, Finance: The Month in Review

From Our Market Correspondent

THE month of May, like so many months that have passed, has brought no relief to the monotony which seems to have settled down on the iron and steel trade. The only item of interest during the month was the joint meeting of the Steel Associations, to which we shall refer later, although nothing of importance was done at that meeting. The Whitsuntide holidays came as a fitting wind-up to a dull period. It is easy to say that the holidays accounted for the dullness of the markets, but the truth is that they would have been dull in any case. There is nothing to give life to the industry at the moment, and as far as one can see, the present conditions are likely to prevail or get worse during the summer months. A detailed survey of the markets only emphasises this unsatisfactory position.

The Pig Iron Position

The pig iron makers are finding difficulty in disposing of their outputs. The ironfounders are short of orders, and are reluctant to buy any considerable weight of iron, even if they have the money to do so. Most of them closed down for the Whitsuntide holidays, and this further reduced the demand for iron from the blast furnaces, which must be kept in continuous operation. The market has been further weakened by the drastic cut in prices made by one or two makers. There has been a fair amount of business placed at these cut prices, which apply particularly to Northamptonshire and Derbyshire.

It is a pity that the consumer should be confirmed in his belief that he has only to wait in order to secure further reductions. Time after time the makers have declared that prices had definitely reached bottom, and just as often they have been forced to retire from that attitude, either because of the urgent necessity of getting orders to keep the furnaces going, or because of the more intense internal competition.

Increase in Continental Price

There has been a welcome increase in the price of Continental pig iron, which has kept this iron out of the British market, although it has not been sufficient to stimulate our own export trade. There is very little demand for basic pig iron. Most of the available output is absorbed by the affiliated steel making plants, and outside sales are of little weight. The hematite iron trade does not improve. Stocks are heavy and new orders are scarce. The demand for finished iron remains poor, although there is no change in prices.

The steel makers still experience a shortage of specifications for steel plates and sections. Here and there some good contracts have been placed, such as the 7,000-ton rail order for the Central Argentine Railway which Bolckow, Vaughan and Co. have taken, but these are not plentiful and do not materially affect the general condition of the trade. The South Wales makers are particularly short of work, and mills are being closed down for this reason. Some of the Scotch works are no better, and the manner in which they cut prices for orders in the Midlands shows how desperate they are. The shipyards are not booking sufficient work to replace their output, and this tells on the North East Coast production of steel.

Shipment and Re-erection of Complete Plant

Some interest was aroused by the announcement that the new steel works which Baldwins built at Margam in South Wales are to be pulled down and re-erected in Australia, a venture in which Baldwins and Dormans are co-operating. The venture may succeed, but it is not too certain, as the Broken Hill works in Australia, with the benefit of their subsidy, are not having an easy task to make a success of their plant.

The prices of the controlled materials, plates, bars and sections, remain unchanged. The decision of the associated makers at their recent meeting not to alter prices, put an end to the little forward buying that was being done in anticipation of an increase. The possibility of such a change in prices was not ignored altogether, and in some quarters there was a disposition to put on increased tonnages at the old prices, but this little spurt did not survive the announcement of the Associations. There could be no reasonable expectation of a reduction in prices, in the present deplorable financial position of the industry. On the other hand, the upward tendency of Continental prices, and the hardening of fuel prices here, might have been regarded as some justification for an increase.

The unsatisfactory feature of the matter is that the meeting of the Associations was known to consumers beforehand, and various devices were adopted to forestall an alteration in prices. The transactions of the Associations and the notices of meetings are supposed to be strictly private, but there is strong suspicion that some of the makers, through their representatives, have endeavoured to take advantage of their inner knowledge, by informing customers of the impending meeting, and giving advice as to the advisability of putting on further contracts before the result of the meeting is announced. Such tactics are not creditable, and no doubt the Associations will take steps to prevent further instances.

Need for United Action

Although members of the Associations, each maker is seeking to advance his own interests primarily, and it is this spirit which will be a stumbling block to any such fusion of interests as there is in Germany. The Associations are in being ostensibly for the promotion of the welfare of the iron and steel industry, but experience seems to show that the general welfare is sometimes sacrificed if necessary to secure individual benefit.

That same spirit can be seen at work in the case of materials which are not controlled. In numerous instances, the general level of prices is forced down by the action of some desperate maker who cuts his selling price below his cost of production in order to gain work which, without this cutting, would have been placed with another maker at a price yielding a margin of profit. The Associations will have to keep strict watch on this tendency, in so far as it affects materials over which control is exercised.

Coal Control Scheme in Operation

The coal control scheme is now in operation, and its effects on the steel trade are being felt. There is considerable difficulty in getting the full deliveries of coal, even against contracts which were placed before the scheme was put into operation, and this shortage is particularly inconvenient at holiday times when the collieries close down for longer periods than the steel works. The same applies to coke for the blast furnaces. Moreover, prices of both coal and coke are hardening, and higher prices are being demanded for renewal of contracts. The scheme has the object of subsidising the export trade in the hope of recapturing some of the foreign markets. Once again the home industries are penalised for the benefit of the foreigner.

During the past month there has been a noticeable increase in Continental prices for steel. It is stated that the home demand in the exporting countries is sufficient to keep them busy. Whether that is true or not, most of the works are not in a position to accept orders for early delivery. Steel plates and small steel bars are now quoted at prices which are so little below the home prices that there is hardly any inducement to send the orders abroad. Very little business is being done in semi-finished steel, as the re-rollers are short of work. The hope has been aroused that this Continental movement may be sufficient to bring about a recovery in the home demand for steel, and so help the steel makers a little out of their depression. It would be premature to count on such a result.

The Question of Safeguarding

In the meantime there is no abatement in the demand for safeguarding. An important political meeting was held on May 14 by the Empire Industries Association, to pass a resolution calling upon the Government to safeguard the steel industry. Sir Robert Horne was chairman, and several Members of Parliament were among the speakers. Although the Government had nothing to do with the meeting officially, it is understood that the President of the Board of Trade was in sympathy with its object. It cannot be overlooked that every industry to which safeguarding has been granted has benefited by it, and it is felt very strongly throughout the trade that the steel industry ought to be given the opportunity.

The production of pig iron in April was 555,000 tons, compared with 592,600 tons in March. The output of steel was also very much down, being 644,100 tons compared with 793,300 tons in March. No doubt the Easter holidays were largely responsible for the decline.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Electrolytic Production of Metals

A PROCESS for producing beryllium by electrolysis of anhydrous beryllium chloride, free from oxide, in a bath of a fused neutral halide or halides of one or more metals electropositive to beryllium, *e.g.*, sodium, is described in Patent Specification 287,734 (Marks), a communication from Kemet Laboratories Co., Inc., of New York, dated April 20, 1927. The electrolysis is preferably effected in a nichrome or chrome-iron container, and in a non-oxidising atmosphere, *e.g.*, of hydrogen. The deposited metal is collected with a minimum of oxidation and converted into a regulus by fusion under a halogen salt which does not react with it, *e.g.*, a mixture of barium chloride and fluoride.

In a companion Specification, 287,762 (Marks), bearing the same date and from the same communicators, there is claimed the production of metals in general by the electrolysis of their halogen compounds in a fused halide electrolyte in a container, constituting the cathode, made of a material containing not less than 5 per cent. of chromium. A chrome-iron alloy containing about 20 per cent. of chromium is specially suitable as offering great resistance to oxidation and corrosion.

According to Patent Application 286,673, bearing the International Convention date March 8, 1927, Siemens and Halske Akt.-Ges. of Berlin propose to deposit tin in coherent form by electrolysis of an alkaline solution which has been treated with an oxidising agent until practically all the tin is present as stannate. The oxidising agent may be ozone, hydrogen peroxide, or a peroxide of an alkali or alkaline earth metal. 1.5 to 10 gm. per litre of gelatine or other colloid is added to the solution.

Recovery of Tin

In a process for detinning tin-plate scrap by the use of a ferric or stannic salt solution, the ferrous or stannous salt produced is regenerated by adding the anion of the used salt to the liquor, the latter being then utilised to dissolve more tin. Thus, when ferric or stannic chloride is used, chlorine gas is passed into the liquor, or nascent chlorine is produced in it to effect the regeneration, and when ferric sulphate is used, sulphur dioxide and oxygen are passed into the liquor in the presence of a catalyst such as nitrogen peroxide. The tin is recovered from the solution either by electrolysis, or by precipitation as oxychloride or hydroxide by steam or air and oxygen, by ammonia, or by caustic alkali or carbonate. See Patent Application 287,892, bearing International Convention date March 29, 1927, by L. U. La Corsa, of Turin, Italy.

In Patent Specification 288,049, dated May 23, 1927, F. Bischitzky, of Aussig-on-Elbe, Czecho-Slovakia, describes a process for recovering tin from alloys or mixtures with other heavy metals. The alloy or mixture is treated on the counter-current principle with hot hydrochloric acid and a non-oxidising catalyst comprising a salt soluble in the acid, preferably calcium chloride. The tin thus passes into solution and is continuously and completely separated from the other metals. The dissolving operation may be interrupted periodically in order to oxidise and disintegrate the still undecomposed residues and return them to the process. The tin may be precipitated from the solution by lime or chalk, thus providing a supply of the catalyst.

Alloys

PATENT SPECIFICATION 288,939 (Wade), dated December 21, 1927, a communication from the United States Smelting, Refining, and Mining Co. of Portland, Maine, U.S.A., comprises a Patent of Addition to the invention of Specification 236,782 (see THE CHEMICAL AGE, Vol. XIII, p. 23 [Metallurgical Section]) for the purification of antimonial lead alloys by subjecting them in a molten state to the action of caustic alkali at a temperature sufficient to cause the arsenic present to unite with the alkali without affecting the antimony. In the present improvement the treatment is carried out at temperatures between 335 and 480° C., the preferred range being 450-460° C.

A refractory iron alloy, free from self-hardening properties, contains 12-20 per cent. of nickel, 16-20 per cent. of chromium,

0.3-3 per cent. of silicon, and up to 1 per cent. of carbon, with or without about 1 per cent. of manganese. See Patent Application 287,876, bearing the International Convention date March 28, 1927, by E. O. Vogel and C. F. C. Weichelt (trading as Meier and Weichelt) of Leipzig, Germany.

Manganese bronzes containing up to 25 per cent. of manganese and also one or more of the metals chromium, iron, titanium, molybdenum, tungsten, vanadium, zirconium, lead, cadmium, antimony, arsenic, tin, thallium, zinc, nickel, cobalt, or silver, are described in Patent Application 286,276, bearing the International Convention date March 2, 1927, Metallbank and Metallurgische Ges. Akt.-Ges. of Frankfurt-on-Main, Germany. There may also be added deoxidants such as aluminium, phosphorus, magnesium, calcium, silicon, or lithium.

In Patent Application 286,616, bearing the International Convention date March 5, 1927, the same applicants describe copper alloys suitable for producing coatings on iron or steel and for use as wire for welding and hard soldering. They contain 0.5-10 per cent. of nickel and 0.5-3 per cent. of iron and silicon, preferably in the form of ferro-silicon, with or without 0.05-6 per cent. of manganese.

Removing Copper from Alloys, etc.

SILVER LEAD, antimonial lead, tin-containing antimonial lead, or like white metal or alloy containing copper as impurity is purified by subjection in a molten condition to the action of sulphur or a sulphur-liberating reagent, *e.g.*, sulphuretted hydrogen, in a reducing or non-oxidising atmosphere, *e.g.*, of sulphur dioxide, the copper being removed as a copper sulphide dross. An agent such as resin may be added to minimize the admixture with the dross of oxides or sulphides of other constituents of the alloys. See Patent Specification 288,004, dated February 21, 1927, by H. Harris of London.

Iron

A STAINLESS and acid-resisting iron alloy is described in Patent Specification 288,861, dated June 30, 1927, by B. D. Saklatwalla of Crafton, Pennsylvania, U.S.A. It contains 1 to 8 per cent. of chromium, 0.5 to 5 per cent. of copper, and 1 to 6 per cent. of silicon, with or without carbon up to 3.5 per cent. The presence of silicon in the alloy results in a better retention of the carbon in the combined form at high temperatures, thus avoiding loss of strength of the material.

Iron ores are reduced, and the iron formed is melted by the combustion of a gaseous fuel, a surface combustion burner being used to produce a combustion gas practically free from oxygen by the complete or nearly complete combustion of the fuel. See Patent Application 287,925, bearing the International Convention date March 30, 1927, by Staal-syndicaat Dr. Ledeboer, of The Hague, Holland.

Zirconium

PATENT SPECIFICATION 287,424, dated November 2, 1927, describes an invention by Rhenania-Kunheim Verein Chemischer Fabriken Akt.-Ges. of Berlin, comprising a Patent of Addition to Specification 282,023 (see THE CHEMICAL AGE, Vol. XVIII, p. 150). The calcined zirconium-lime products, obtained as in the parent Specification, are treated with hydrochloric acid of such a concentration that a solution is obtained which, in the cold, is almost saturated with calcium chloride. The acid is employed in amount insufficient to transform the basic constituents in the calcined products wholly into chlorides and, after separating the insoluble constituents, a further quantity of the acid is added to the solution to crystallise out the zirconium oxychloride.

Platinum

A PROCESS for the extraction of platinum and similar precious metals (palladium, rhodium), particularly from South African norite and dunite ores, or concentrates, is described in Patent Specification 289,220, dated March 10, 1927, by S. C. Smith of London. The ore, etc., is treated with hydrochloric acid in conjunction with chlorine gas or with a substance (other than nitric acid), *e.g.*, a chlorate, manganese dioxide, or a hypochlorite, capable of producing evolution of chlorine during the treatment. Soluble non-precious metals may be removed in part by a preliminary treatment with acid, preferably sulphuric. Sulphide ores may be subjected to a preliminary roasting, and non-sulphide ores to a preliminary heating designed to prevent formation of gelatinous silica in the subsequent precipitation of the platinum, etc., *e.g.*, by zinc powder.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—The system sodium-tin. W. Hume-Rothery. *J. Chem. Soc.*, April, pp. 947-962. Nine compounds exist in the system: Na_4Sn , Na_3Sn , Na_2Sn , Na_3Sn_2 , NaSn , NaSn_2 , NaSn_3 , NaSn_4 , and NaSn_6 .

A profound change in a nickel-copper alloy in superheated steam at about 350-400° C. J. F. Saffy. *Comptes Rendus*, April 23, pp. 1116-1118 (in French).

Contribution to the knowledge of Heusler's alloys: On manganese-aluminium-copper. O. Heusler. *Zeitschrift anorganische Chem.*, Vol. 171, Parts 1-2, pp. 126-142 (in German).

The potentiometric analysis of binary, ternary, and quaternary tin alloys. H. Brintzinger and F. Rodis. *Zeitschrift Elektrochem.*, May, pp. 246-250 (in German). Deals with binary alloys of tin and antimony, tin and copper, bismuth and tin, iron and tin; ternary alloys of copper, tin, and bismuth; iron, tin, and bismuth; antimony, copper, and tin; and quaternary alloys of antimony, copper, tin, and lead.

ANALYSIS.—Iodimetric determination of vanadium in alloy steels and ferrovanadium. K. Roesch and W. Werz. *Zeitschrift analytische Chem.*, Vol. 73, Parts 9-10, pp. 352-356 (in German).

CORROSION, ETC.—The corrosion of metals. W. M. Guertler. *Trans. Amer. Soc. Steel Treating*, May, pp. 759-794. The author is of the opinion that the basis of all commercial acid-resisting alloys must necessarily be the group of elements iron, nickel, and copper. No permanently durable alloy can ever be developed which will be resistant to all acids.

Cadmium as corrosion-protection for light metals. J. Dornauf. *Korrosion und Metallschutz*, May, pp. 97-102 (in German).

The value of lead colours for purposes of metal protection. A. Eibner and W. Laufenberg. *Korrosion und Metallschutz*, May, pp. 107-110 (in German).

ELECTRODEPOSITION.—The present position of the technique of chromium plating. A. Siemens. *Zeitschrift für Elektrochem.*, May, pp. 264-269 (in German).

GENERAL.—The swelling in hydrogen of metals and alloys containing a little oxide. M. Guichard, Clausmann, and Billon. *Comptes Rendus*, April 23, pp. 1121-1123 (in French).

The electrolytic refining of noble metals. F. Chemnitz. *Chemiker-Zeitung*, May 16, pp. 385-388 (in German).

The electrical conductivity of silver alloys. M. Hansen and G. Sachs. *Zeitschrift Metallkunde*, April, pp. 151-152 (in German). Determinations of the conductivity of mixed crystals of silver with cadmium, zinc, magnesium, manganese, antimony, aluminium, and tin; comparison with hardness; influence on electrical conductivity of the position of the elements in the Periodic Classification.

The pickling of metals with the addition of inhibitors. W. H. Creuzfeldt. *Korrosion und Metallschutz*, May, pp. 102-107 (in German).

New tendencies of development in the German metal trade. *Die Metallbörse*, May 19, pp. 1097-1098; May 23, pp. 1125-1126 (in German).

Aircraft metallurgy. H. C. Knerr. *Trans. Amer. Soc. Steel Treating*, May, pp. 723-758. A brief outline of the metallurgy of aircraft manufacture, including choice of materials, specifications, inspection, metals used and their properties, processes of machining, forming, rivetting, welding, etc., corrosion prevention, causes of failure, etc.

On the determination of the heterogeneous field in the iron-nickel system. K. Honda and S. Miura. *Trans. Amer. Soc. Steel Treating*, February, pp. 270-281.

MECHANICAL PROPERTIES.—Changes of tensile strength and conductivity in hard-drawn wires of copper, bronze, aluminium, Aludur, and Aldrey under the influence of heating of short duration. H. Bohner. *Zeitschrift Metallkunde*, April, pp. 132-141 (in German).

Expansion characteristics of low-expansion nickel steels. H. Scott. *Trans. Amer. Soc. Steel Treating*, May,

pp. 829-847. Describes an expansion test apparatus with which continuous thermal expansion curves can be obtained with accuracy from liquid air temperature to 600° C. Expansion curves were taken on a series of low-expansion nickel steels and synthetic iron-nickel alloys.

PASSIVITY.—Observations on the passivity of metals. E. S. Hedges. *J. Chem. Soc.*, April, pp. 969-978.

SINGLE METALS.—The overheating of aluminium. M. Suhr. *Revue de l'Aluminium*, January-February-March, pp. 581-583 (in French).

STEEL.—Two kinds of martensite. K. Honda and S. Sekito. *Nature*, May 12, p. 744. Indicates that in quenched steel two kinds of martensite exist: α martensite in the surface layer, and β martensite in the inner portion.

Patenting of steel. J. S. G. Primrose. *Trans. Amer. Soc. Steel Treating*, April, pp. 617-637. The mechanism and purpose of the form of heat treatment known as "patenting" is explained, and the different forms of furnaces and heating used, and the different classes of steel commonly treated for particular purposes, are described.

Alloy steels for boiler construction. C. McKnight. *Trans. Amer. Soc. Steel Treating*, April, pp. 638-658.

WELDING.—Welding aluminium castings. A practical description of the work involved. W. Mason. *Metal Industry* (New York), May, p. 205.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

COOK (JOSEPH) SONS AND CO., LTD., Washington, ironfounders, etc.—Registered April 24, £16,000 debentures; general charge (except certain properties comprised in mortgage dated March 10, 1916 and charge dated March 26, 1926); also registered April 24, debenture to Bank; general charge (except as above). *£240. August 11, 1927.

MONDEGO TIN DREDGING CO., LTD., London, E.C.—Registered May 1, £1,000 debentures, part of £10,000; general charge. *£59,500. March 23, 1928.

PA VALLEY TIN FIELDS, LTD., London, E.C.—Registered April 17, series of £3,000 debentures, present issue £1,050; general charge.

SHEEPBRIDGE COAL AND IRON CO., LTD., Chesterfield.—Registered April 18, £500 debentures, part of £750,000; general charge (except uncalled capital and certain property). *£580,000. October 10, 1927.

Satisfactions

BARTLE (JAMES) AND CO., LTD., London, W., ironmasters.—Satisfaction registered May 10, all moneys, etc., registered February 14, 1923.

BLACKETT HUTTON AND CO., LTD., Gainsborough, ironmasters.—Satisfaction registered April 17, £7,000 registered January 26, 1917.

GLAMORGAN HEMATITE IRON ORE CO., LTD., Cardiff.—Satisfaction registered April 28, £7,353 15s., part of amount registered July 6th, 1921.

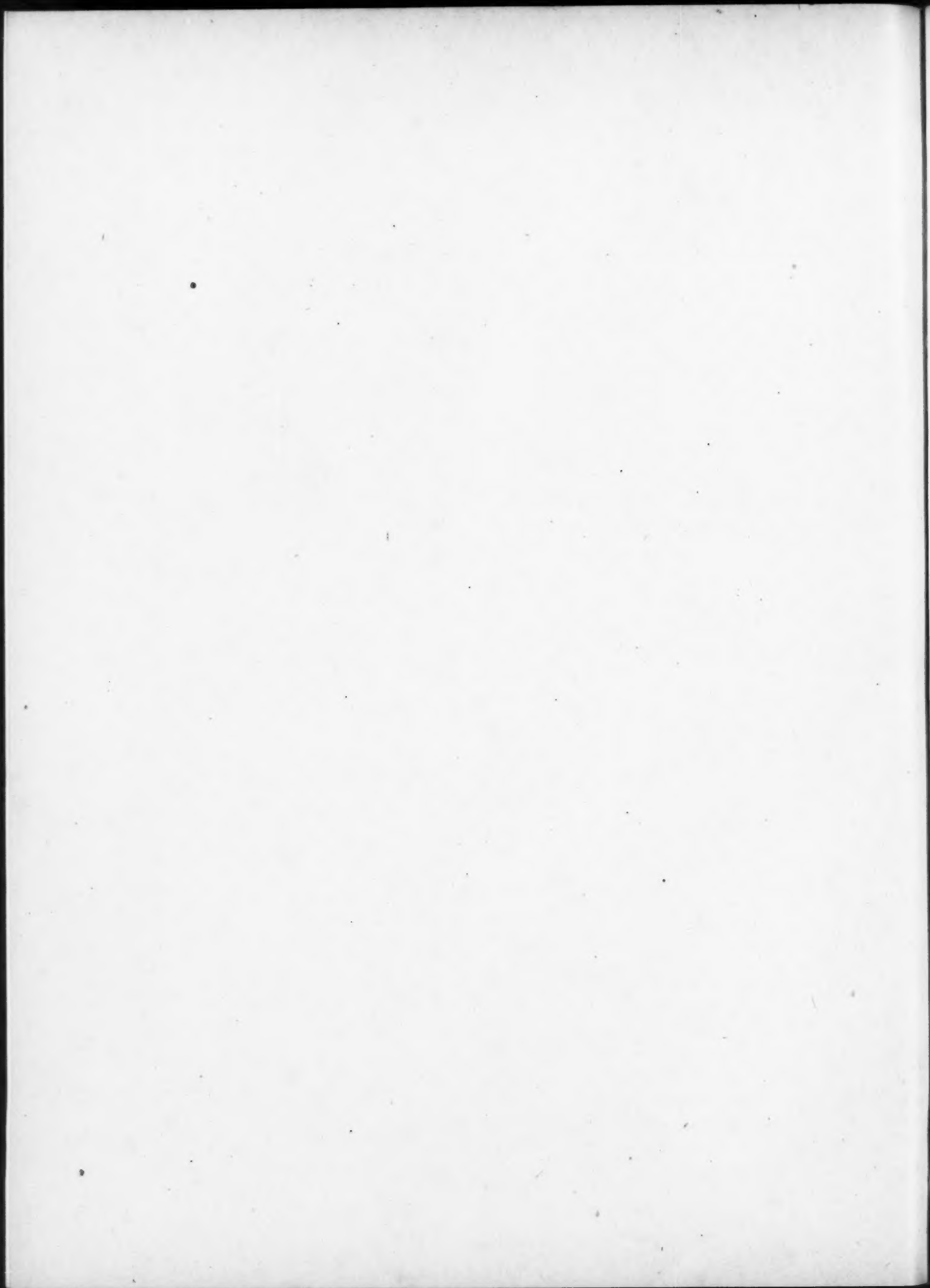
SHARDLOW (AMBROSE) AND CO., LTD., Sheffield, ironfounders.—Satisfaction registered May 9, £50,000 registered May 24, 1918.

London Gazette, &c.

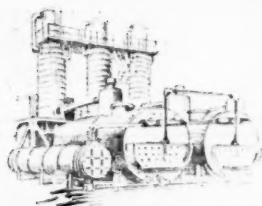
Company Winding Up Voluntarily

BROUGHTON COPPER CO., LTD.—By special resolution, April 30, confirmed May 15. T. F. Grundy, 4, Broad Street Place, London, E.C.2, Incorporated Accountant, appointed as liquidator.

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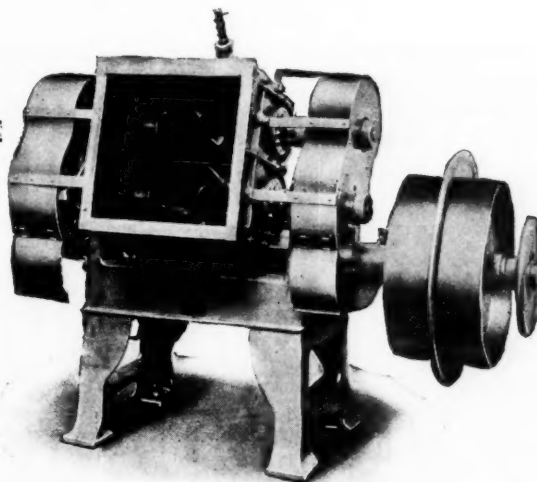
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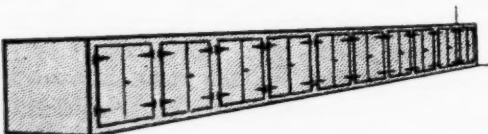
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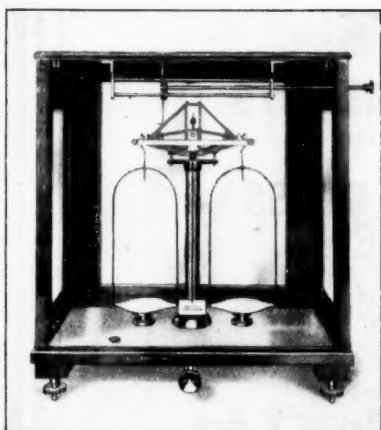
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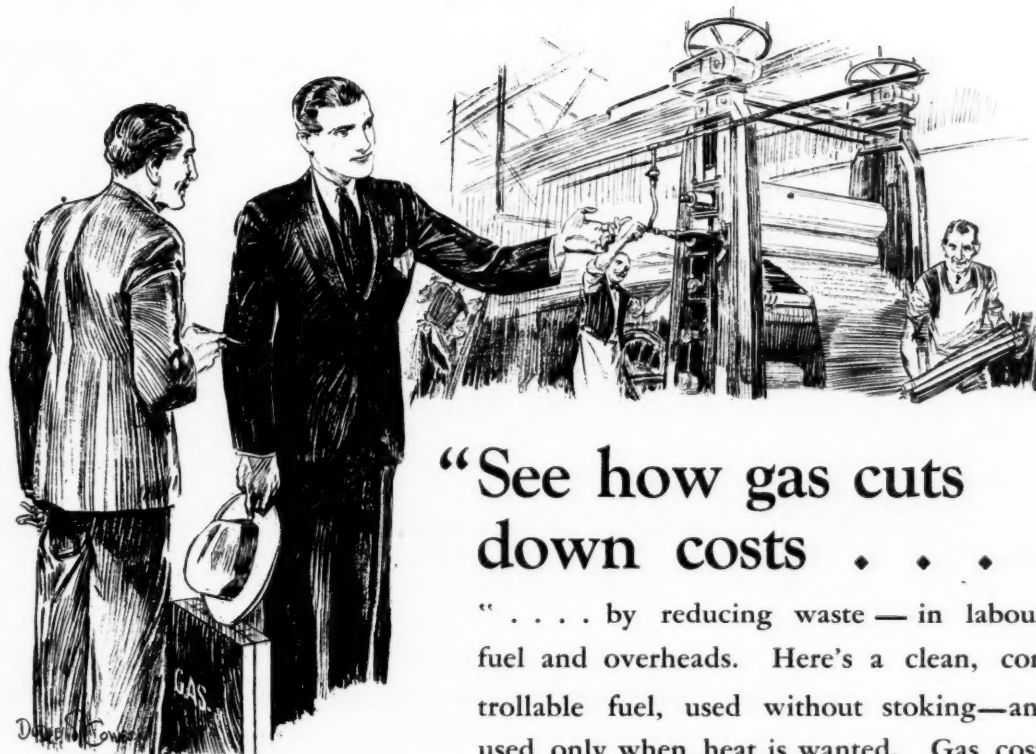
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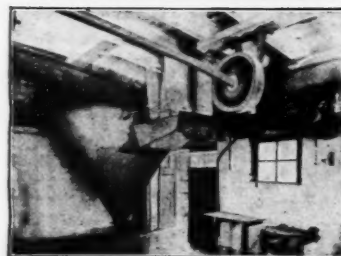
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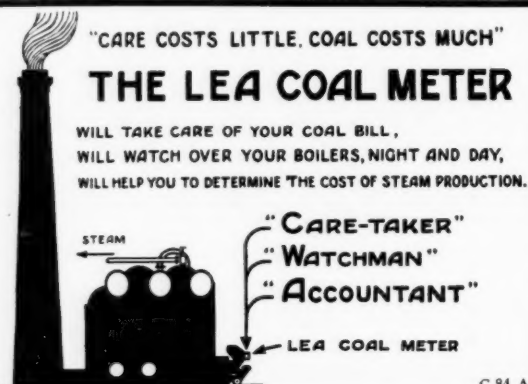
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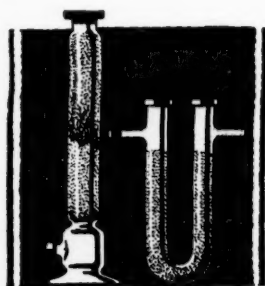
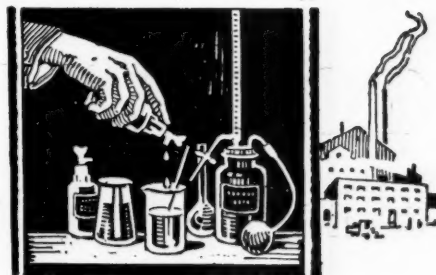
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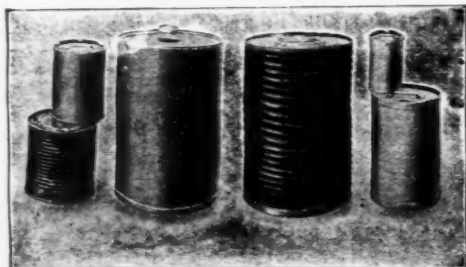
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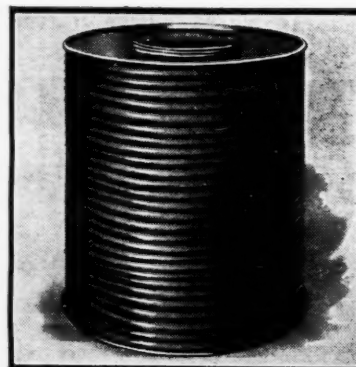
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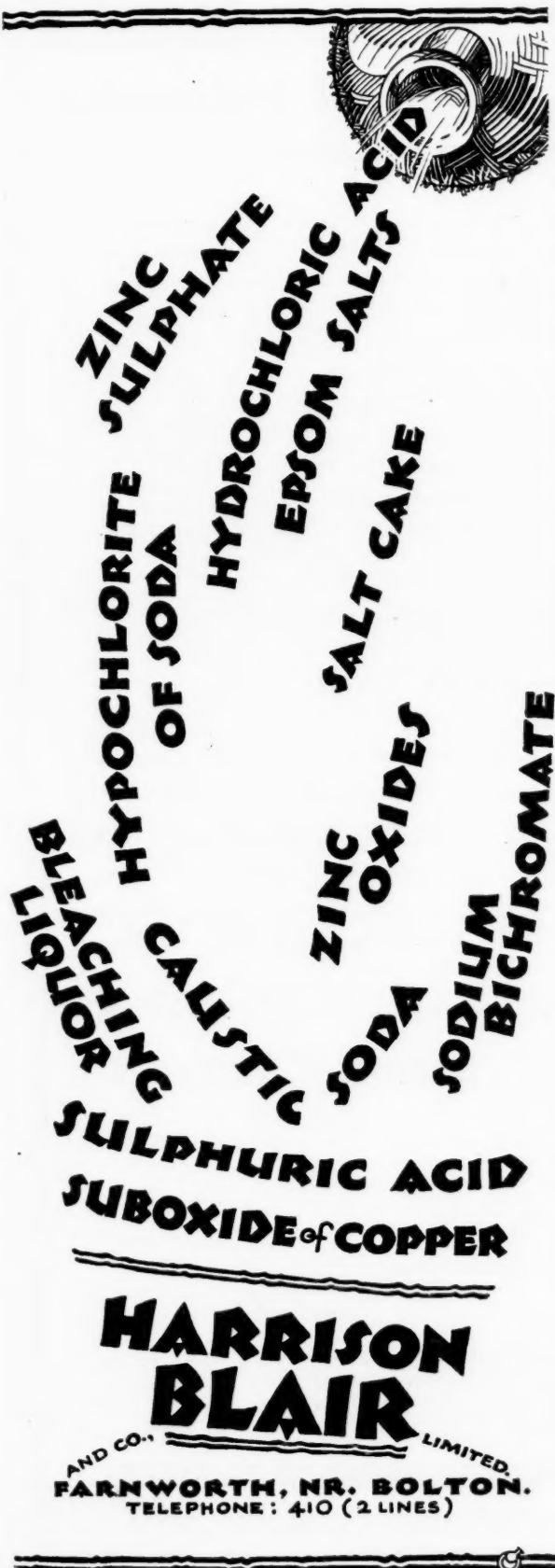
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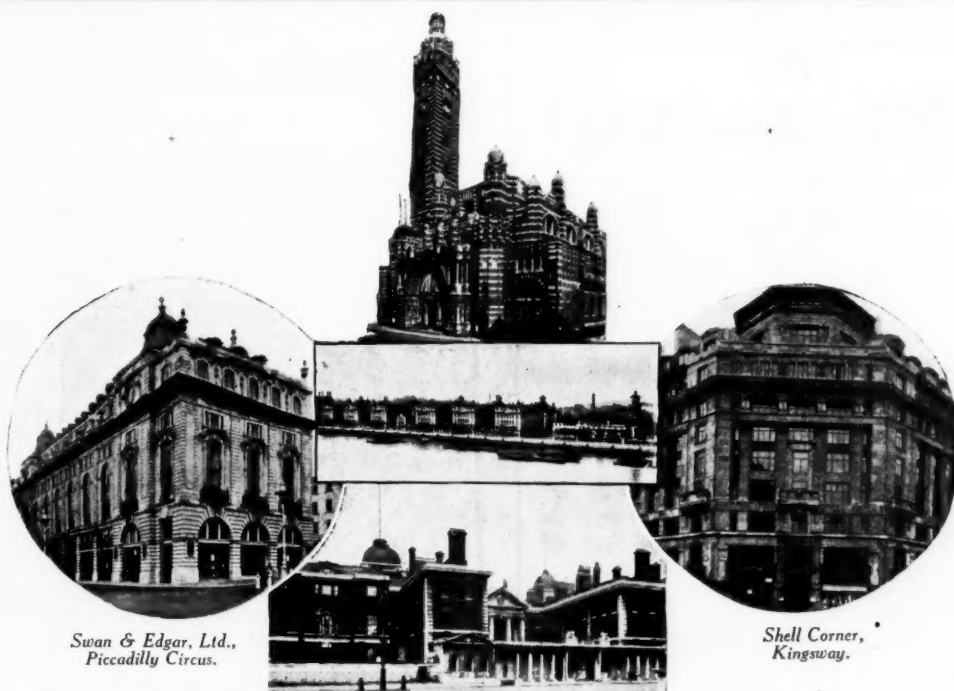
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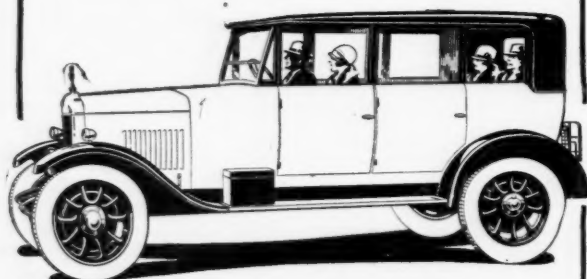
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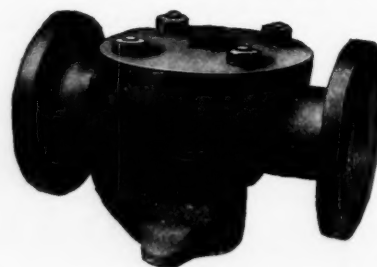
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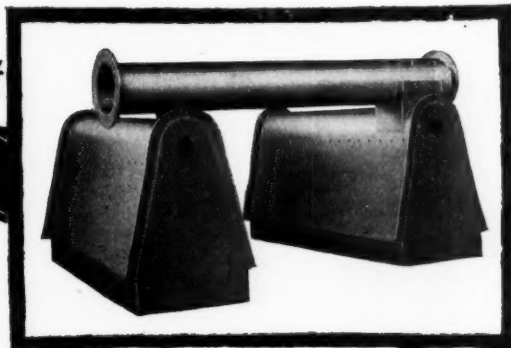
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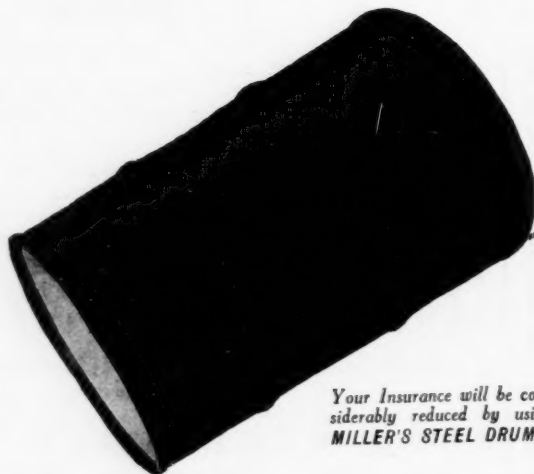
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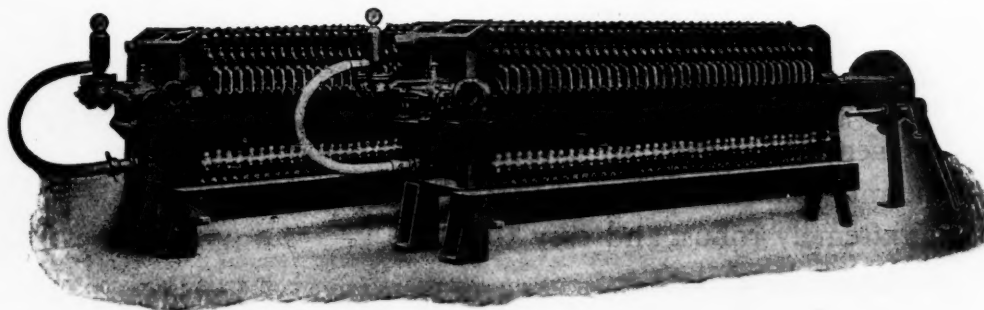
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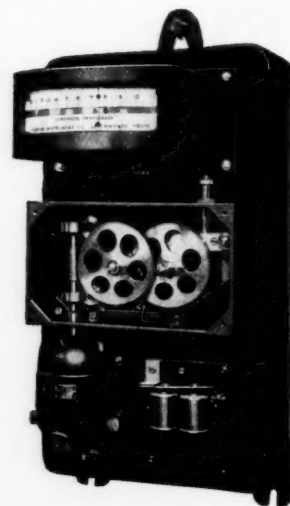
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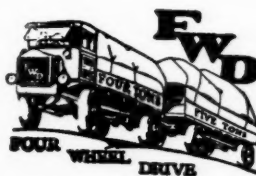
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SPECIAL NOTE.

Trade announcements, other than strictly second-hand and job lines, etc., cannot be inserted in these pages, except by firms whose advertisements are running in our displayed columns.

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2 Copper-Jacketed Tilting Pans, 40 and 60 gals.
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Telephone: East 0379.

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WANTS**

EDWARD RUSHTON, SON AND KENYON, Auctioneers, Valuers and Fire Loss Assessors of Mills, Works, and Machinery of all kinds, 13, Norfolk Street, Manchester.

Tel. Nos. 775 City and 5633 City. (Estab. 1855.) Telegrams: "Rush-ton, Auctioneers, Manchester." And 21, Richmond Terrace, Blackburn.

GRINDING of every description of chemical and other materials for the trade with improved mills.—**THOS. HILL-JONES, LTD.**, "Invicta" Mills, Bow Common Lane, London, E. Telegrams: "Hill Jones, Pop, London." Telephone: 3633 East.

SYNTHETIC Resins, Varnishes, Moulding Powders, Moulded Products. Manufacture and Application Consultant and Specialist.—**W. OLIVER**, Church Street, Cleckheaton, Yorks.

TRADE grinding done. Inquiries invited for chemicals, etc., etc.—**ALGIN CO., LTD.**, 12, Norfolk Street, Strand, W.C.2. 'Phone, Central 3781, Rainham 60.

WANTED, Varnish Filter Press, good working condition. Approximately 18 in. plates with 12 or more sections.—Offers, with full particulars, to Box 939, **THE CHEMICAL AGE**, Bouverie House, 154, Fleet Street, E.C.4.

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NAPHTHA FOR SALE.—Solvent and Heavy Naphtha, water-white. Rubber and Paint Manufacturers please inquire.—**BROTHERTON AND CO., LTD.**, Leeds.

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(Appointment 102). Candidates should have had considerable experience in an Acid Works and must have had experience of Sulphuric Acid manufacture (chamber process). Preference will be given to a candidate who also possesses a knowledge of any of the following processes, (a) Nitric Acid manufacture (from Nitrate of Soda); (b) Concentration of Sulphuric Acid (Kessler process); (c) Treatment of residual acids from gun cotton and Nitroglycerine manufacture; (d) knowledge of mixing acids

**OFFICIAL
APPOINTMENTS—continued.**

for manufacture of guncotton and nitroglycerine. Applicants should be between 25-35 years and capable of controlling labour.

Terms:—Salary Rs. 450-15-510 per mensem, with prospects of further increases. Agreement for five years in first instance. Free second-class passage to India and return passage on satisfactory termination of services. Free quarters. Medical examination. Further particulars and forms of application may be obtained on request by postcard (quoting appointment 102), from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor Gardens, London, S.W.1. Last date for receipt of applications July 21st, 1928.

**UNIVERSITY OF LONDON,
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IN CHEMICAL ENGINEERING.**

THE University College Committee will shortly appoint a Lecturer in the Department of Chemical Engineering, which is under the direction of Professor W. E. Gibbs. The Lecturer should be a graduate in Engineering of a British University and have had some training in Chemistry. Industrial experience is also desirable. Salary £350 to £450, according to previous experience.

Particulars may be obtained from C. O. G. DOUIE, University College, London, Gower Street, W.C.1.

SITUATIONS VACANT

ASSISTANT CHEMIST required for Food Factory, near London. Honours Degree (or equivalent qualification) and some experience essential.—Reply, full details, salary expected, &c.—Box 960, **THE CHEMICAL AGE**, Bouverie House, 154, Fleet Street, London, E.C.4.

CLASSIFIED ADVERTISEMENTS**SITUATIONS VACANT**

—continued

CHEMIST wanted for Colonies, with practical experience in distillation of Essential Oils, Essences and preferably also of manufacture of Caramel. State experience and salary required.—Box N. 739, c/o JACKSONS, 19, Cullum Street, London, E.C.3.

THE British Manufacturers of a Rotary Filter Plant invite applications for the position of Representative from gentlemen having an established reputation as Chemical Engineering Salesmen in the Chemical and Allied Industries. Applications should be made by letter stating experience, qualifications and salary required.—Box 962, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, E.C.4.

WANTED, a good man, for America to erect and take charge of a Plant making Anthraquinone; must have had practical manufacturing experience with the latest method; state some particulars of experience; liberal salary will be paid for a term of years; replies will be treated as strictly confidential.—U.S.A., E. L. E. 4163, c/o RUDOLF MOSSE, LTD., 125/130, Strand, London, W.C.2.

SITUATIONS VACANT

—continued.

REPRESENTATIVE wanted for the sale of Stoneware Apparatus for the chemical industry. Specialist in Chemical Works Plants preferred.—Apply to TONWERKE, Berlin-Charlottenburg.

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PATENTS obtained, trade marks and designs registered, at home and abroad.—GEE AND Co., Patent and Trade Marks Agents. (Patent and Trade Mark advisers to THE CHEMICAL AGE), 51-52, Chancery Lane, London, W.C.2. Telephone: Holborn 1525. Established 1905.

PATENTS AND TRADE**MARKS—continued**

KING'S PATENT AGENCY, LTD. (B. T. King, Registered Patent Agent, G.B., U.S., and Can.), 146A, Queen Victoria Street, London, E.C.4. Advice Handbook and Cons. free. 40 years' refs. 'Phone: Central 0682.

THE Proprietors of British Patent No. 164627 are prepared to sell the Patent or to licence British manufacturers to work thereunder. It relates to lead chambers for the manufacture of sulphuric acid.—Address: BOULT, WADE AND TENNANT 112, Hatton Garden, London, E.C.1.

THE owner of British Patents Nos. 233874 and 230663, for Improvements relating to Cellulose—derivative compositions, is desirous of entering into negotiations with one or more firms for the purpose of exploiting the above inventions either by the sale of the patent rights or by the grant of a licence or licences to manufacture on royalty. Enquiries should be addressed to ABEL AND IMRAY, 30, Southampton Buildings, London, W.C.2.

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Please type; or write in block capitals.

